THE

ELECTRICAL REVIEW.

VOL. LIX. NOVEMBER 9, 1906. No. 1,511.

ELECTRICAL REVIEW.

Vol. LIX.] CONTENTS: November 9, 1906. [No. 1,511.

	Page
The Borough Elections	733
Design Coefficients for Dynamo-Electric Machines (*illus.*) (*continued*)	735
New Electrical Devices, Fittings, and Plant (*illus.*)	738
New South Wales Tramways	741
Breakdowns of Machinery in 1905	742
Legal	742
Correspondence	743
The L.C.C. Bulk Supply Scheme	745
Business Notes	745
Two Electrical Factories at Birmingham (*illus.*)	750
City Notes	760
Electric Tramway and Railway Traffic Returns	762
Stocks and Shares	762
Share List of Electrical Companies	763
Metal Market.—Fluctuations in October	765
The Electrical Froissart Chronicles.—XI.	765
Competition	766
Electricity Supply in Birmingham: The New Summer Lane Station (*illus.*) (*concluded*)	768
Proceedings of Institutions:—	
High-Speed Electric Machinery: With Special Reference to Steam Turbine Machines (*illus.*) (*continued*)	770
Birmingham Association of Mechanical Engineers	771
Society of Engineers	771
New Patents Applied For	772
Published Specifications	772

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THE BOROUGH ELECTIONS.

WE cannot in the interests of our readers refrain from some comment upon the results of the Municipal Elections which took place on November 1st.

What does the result of the elections portend? This, if nothing else—that ratepayers in London are at long last waking up to the fact that there is such an evil as municipal extravagance; that, so long as the so-called Progressive candidates have their own way, that extravagance bids fair to continue. But there is something else. If we merely have regard to the numbers of electors who went to the poll, this is itself a valuable sign of the times; it shows that the middle-class ratepayer has begun to exercise the franchise in municipal affairs. He has begun to realise that it is worth his while to go a few paces out of his way in order to record his vote in favour of economy. Again, the result of the elections, in so far as it amounts to the defeat of Labour and Socialism, is an indication that the Middle classes, who, after all, bear the lion's share of the burden of the rates, still have a controlling voice in their expenditure.

There can be no doubt that amongst the industries which have suffered most severely at the hands of the Municipal trader that with which this journal is more particularly concerned takes a foremost place. When charged with extravagance in providing electric light for his district, the Progressive is heard to say, "True, the outlay was great, but look at the sum of £—— which we have been able to write off against the rates." Fortunately for the honest ratepaying citizen, the unreality of this assertion is becoming manifest to all. In spite of the alleged profit, the trend of the rates is ever upwards—and ever will be, in our humble judgment, so long as those responsible for local government endeavour to compete with legitimate private enterprise.

What may ratepayers in general, and the electrical world in particular, expect from Municipal Reform? Economy? Yes; but by slow degrees; for it must be remembered that by years and years of mismanagement London, as a whole, has been committed to wild extravagance. Taking their cue from the London County Council — sometimes misnamed the Mother of Local Authorities—the Metropolitan Boroughs (in so far as they have been Progressive) appear to have stopped at no expenditure. In the result debt has accumulated, and upon that debt interest must be paid. This is the burden which the Municipal Reformer is expected to remove from the shoulders of the ratepayer, but if he fails to shift it at once he cannot be justly blamed. But there are some things which he can do "right now" (as the Americans say). He can insist upon tenders being accepted in the interests of the ratepayers, not of the firm or firms making the tender. He can refuse to allow the fact that a particular tender comes from within his district to bias his judgment. We trust that the ruinous

policy of the Poplar Guardians in this matter of tendering may never more be adopted. Again, the absurd system of providing for Union rates of wages in contracts with the local authority should be dropped, and that quickly. What right have members of a local body, who are mere trustees of the rates, to do anything but get work properly done at the lowest price possible? If Poor relief is necessary—as it too often is—there are other channels through which it may flow; but we cannot admit that any local authority should be dictated to by the officials of any Union.

We understand that there is a movement on foot to promote the equalisation of rates throughout the metropolis. Strongly as this idea should be opposed, one can look upon it with greater equanimity now that, as a result of the recent polling, 25 out of the 27 London boroughs have declared for municipal reform.

While, as we have pointed out, we welcome the accession to power of men who make the name Reformer their title and Economy their policy, we trust that the municipal electorate may show the same spirit in the County Council elections next year. There is no reason why the result should not be the same, seeing that the borough electors were included in the new register, which will still be in force next April. So far from setting an example of economy, the County Council would seem to preach expenditure in their every action. Witness their Thames steamboats and their present wild proposal to undertake the supply of electricity to London on a stupendous scale. Even in the preliminary negotiations relating to this latter undertaking they have shown no regard for economy. Mr. Merz's Bill of 1904-5 was bitterly opposed, at enormous expense, by the Council. At the end of 1905 they brought forward an ill-considered scheme, for which they could not even obtain the sanction of a Liberal Parliament. Nothing daunted, they are prepared with another scheme, which was set forth in some detail in our last issue.

Last week the Council, for the sake of appearances, we suppose, thought they were going too fast in tramway matters, so they are holding some of their extensions back for the present. This week they have approved of a proposal to saddle London ratepayers with financial responsibilities for an undertaking to supply electricity over an area of 451 square miles, at a cost of who-knows-how-many millions. If London electors do not express themselves very plainly next March on this particular piece of recklessness, we shall be indeed surprised, but between now and then we shall have occasion to thoroughly analyse the scheme. In the meantime, we can only hope that before it comes before Parliament the County Council will have an entirely altered constitution.

The Wireless Telegraphy Conference.

On Saturday last the Conference concluded its labours, and the terms of the Convention were disclosed; we give elsewhere a number of the principal clauses. There is little doubt as to the ratification of the treaty by the British Government, though it will probably come before Parliament for discussion, and of the foreign delegates only the Italians anticipate difficulties in this respect.

It appears that the British delegates were instructed to agree to the principle of intercommunication between land stations and ships in general within reasonable limits, whatever the system employed, but with the reservation that any Power might exempt as many of its stations as it thought fit. This reservation, however, was renounced by Germany and the United States. The last-named, on the other hand, advocated compulsory intercommunication between ships at sea; this proposal was too far-reaching for our acceptance, and was relegated to a supplementary convention, in which Great Britain, Japan and Italy bear no part.

It will be seen, therefore, that, on the whole, our Government has retained a free hand, the power of exemption having a very wide scope, while naval and military wireless stations are entirely unaffected by the treaty. The fundamental innovation is that a sufficient number of wireless stations must be established round our coasts, and presumably those of our Colonies and dependencies, to permit of general interchange of telegraphic communications with ships at sea. How this will work out in practice remains to be seen; unless the number of stations is severely restricted, there will be a great liability to confusion. It must be remembered that up to this moment general intercommunication has never taken place at all; consequently we are working entirely in the dark as to the conditions that will obtain under the new *régime*, and it is essential that any steps that may be taken shall be the subject of the strictest caution and most careful consideration.

Col. Yorke on Brakes.

At the time of our going to press last week, we had only had an opportunity to exame abstracts of Col. Yorke's report to the B. of T. on the Highgate accident, and since we have read the full report, we have been struck more than ever with the masterly way in which its author has handled the subject of brakes.

He objects to the way in which wheel blocks are set up with no more than $\frac{1}{16}$ in. or $\frac{1}{8}$ in. clearance as a maximum. This he found to be the case at Highgate, and we know very well that brake setters rarely allow more clearance on new blocks, their idea being that a few hours' use will adjust them properly, and that no more attention need be given to that car for several days, after which the blocks will be set up again close to the wheels. If the gravity release brake rigging used, for instance, by the Metropolitan Tramways of New York, were in fashion here instead of the spring release, this nicety of adjustment would not matter so much; but with things as they are, the springs do not get a fair chance unless the clearance is substantial. It must be remembered in this connection that with a leverage of 100 to 1 the brake handle must be turned through 25 in. to move the blocks $\frac{1}{4}$ in. (P. Dawson), so that any clearance over the $\frac{1}{2}$ in. recommended by Galton, who is quoted by Col. Yorke, means an excessive amount of lost motion before the blocks can be applied to the wheels.

Some makers design the brake hangers and heads so that the blocks are hung with their centres below the wheel centres, and there have been instances of brakes properly hung by the truck-makers slightly above the wheel centre, being deliberately altered in the car shops under the impression that a more effective arrangement was being made. Col. Yorke points out that the tendency when the wheels are trying to carry the blocks upwards over the centre is to jam them, and so to produce skidding.

When reviewing the present position of the slipper brake, Col. Yorke quotes Mr. Fell's remark that he will not feel satisfied until a supplementary attachment is provided, so that the magnetic track brake shoes can be operated by hand if necessary. Such an attachment is very desirable, and it is a foregone conclusion that when the design is perfected neither method of application will derange the other in the least degree.

In case anyone should think that our leading article last week did Col. Yorke less than justice, we quote here a few sentences which were not available on the previous occasion:—

> Judging from the remarks one hears, it would seem that an idea is abroad that greater brake power should be given to the motorman. If by this it is intended that he should merely have means of applying greater pressure to the brake blocks, it is doubtful

whether such a provision is necessary or desirable. The ratio between the pressures on the hand brake handle and on the brake blocks is already, judging from the frequency with which the wheels are skidded, more than sufficient. The only result, under present conditions, of giving the motorman more power would be that the wheels would be skidded still more frequently. . . . It is, therefore, useless—and, in fact, detrimental—to give the motorman power to increase the pressure of the brake blocks, unless at the same time the adhesion between the wheels and the rails can be increased. This can only be done in two ways—(1) by substituting steel-tired wheels for the chilled wheels—the coefficient of friction between cast-iron chilled wheels and steel rails being less than between steel wheels and the rails . . . (2) by the use of sand. But when all has been done, there is a limit to the adhesion between the wheel and the rail, which puts a limit to the possible amount of braking effect obtainable from the wheel brakes. The advantage gained by the use of the ordinary track brakes lies chiefly in the higher coefficient of friction, which can be obtained by the choice of suitable material for the shoes, over that existing between the wheels and the rails; this higher coefficient being applicable to so much of the weight of the car as is carried upon the track brakes. With the electro-magnetic track brake the conditions are somewhat different, as the pressure of the shoes on the rails depends solely upon the magnetic attraction between them, and has nothing whatever to do with the weight of the car, so that the braking efficiency of the wheels is not affected.

Attention is drawn by Col. Yorke to the multiplicity of pedals and handles which the driver is supposed to use, in some cases all at once. There is the sand pedal, the gong pedal, sometimes the life-guard pedal, and always the brake-staff pawl to be manipulated by the feet, as the Irishman may have said, while two hands have to deal simultaneously with two controller handles and at least one brake handle, two if a hand-worked track brake is fitted. As the Colonel says:—

It seems hardly credible in these days of engineering inventiveness that, with so large an amount of power in the form of electric energy available upon a car, all these operations should still have to be performed in such a primitive fashion.

While we think it due to Col. Yorke to make his attitude on the brake theme clearer than we were able to do last week, we find ourselves still of the same opinion as we then expressed.

An Evergreen Misconception.

We have become so well accustomed to hearing from more or less irresponsible or interested sources that all electric brakes rely for their operation upon a supply of energy from the trolley wire, that we do not weary our readers by informing them on each occasion, but we feel bound to mention the matter again when we find our contemporary the *Light Railway and Tramway Journal* giving this oft-killed fallacy the prominence of an editorial article in the current issue.

The writer has been saying how much at sixes and sevens everyone seems to be about the most suitable brake, and, with good sense, warns his readers that every tramway system has its local peculiarities, which must be considered before adopting any particular kind of brake. He thinks it curious that the air-brake which is used so much in America and in Europe is comparatively unknown here, but adds that some of the speakers at the recent meeting of the Street Railway Association in New York deemed air-brakes unsuitable for single-truck cars, or for any cars used principally on city service.

Then, alas, he approaches electric brakes, saying of the regenerative system that while it is claimed to be easy on the motors, economical, smooth in action, and capable of being automatically operated, it has the same drawback as all other electric brakes, as being dependent for its action upon the trolley wire.

After that remark it is fortunate that the writer did not proceed to review Col. Yorke's report on the Highgate accident at any length, or to criticise it at all, and it is unfortunate that the "egregious blunder" successfully passed the editorial eye.

It is unnecessary for us to do more than quote the passage, as the facts are so well known to our readers, and we can only hope that the subscribers to the Journal in question are in the same position.

DESIGN COEFFICIENTS FOR DYNAMO-ELECTRIC MACHINES.

By H. M. HOBART and A. G. ELLIS.

(*Continued from page* 727.)

To show still further that the total works cost does not depend materially upon the output coefficient, a number of designs have been prepared for a continuous-current shunt-wound generator of 100 KW. rated capacity, 500 terminal volts, and a speed of 400 R.P.M. The data of these designs are brought together in Table II. In this table the designs are divided into groups of three different gap diameters, namely, 65, 80 and 95 cm., for four, six and eight poles respectively. These machines all have the same rated output, the same speed and the same value for $D^2 \times \lambda g$, and therefore the same output coefficient. The outline drawings for these machines are shown in figs. 9 to 17, p. 736. Those in the first horizontal row (figs. 9, 10 and 11) are designed with four poles, those in the second (figs. 12, 13 and 14) with six poles, and those in the third (figs. 15, 16 and 17) with eight poles. In the left-hand vertical row, an air-gap diameter (D) of 65 cm. is taken. In the second vertical row $D = 80$, and in the third vertical row $D = 95$ cm. The four-pole machines in the first horizontal row (figs. 9, 10 and 11) have cast-steel yokes on account of the large flux per pole.

The six and eight-pole designs in the second and third horizontal rows (figs. 12 to 17) have a correspondingly smaller flux per pole, and would require a yoke of lesser cross-section than the four-pole designs. As, however, in the interests of stability it is not advisable to use a much smaller cross-section of yoke than that already used in the four-pole designs, cast-iron yokes have been employed in the six and eight-pole machines. This will make practically no difference in the comparative cost for effective material, the market prices being such that the increased weight of cast-iron requires about the same initial outlay as for the lesser quantity of cast-steel.

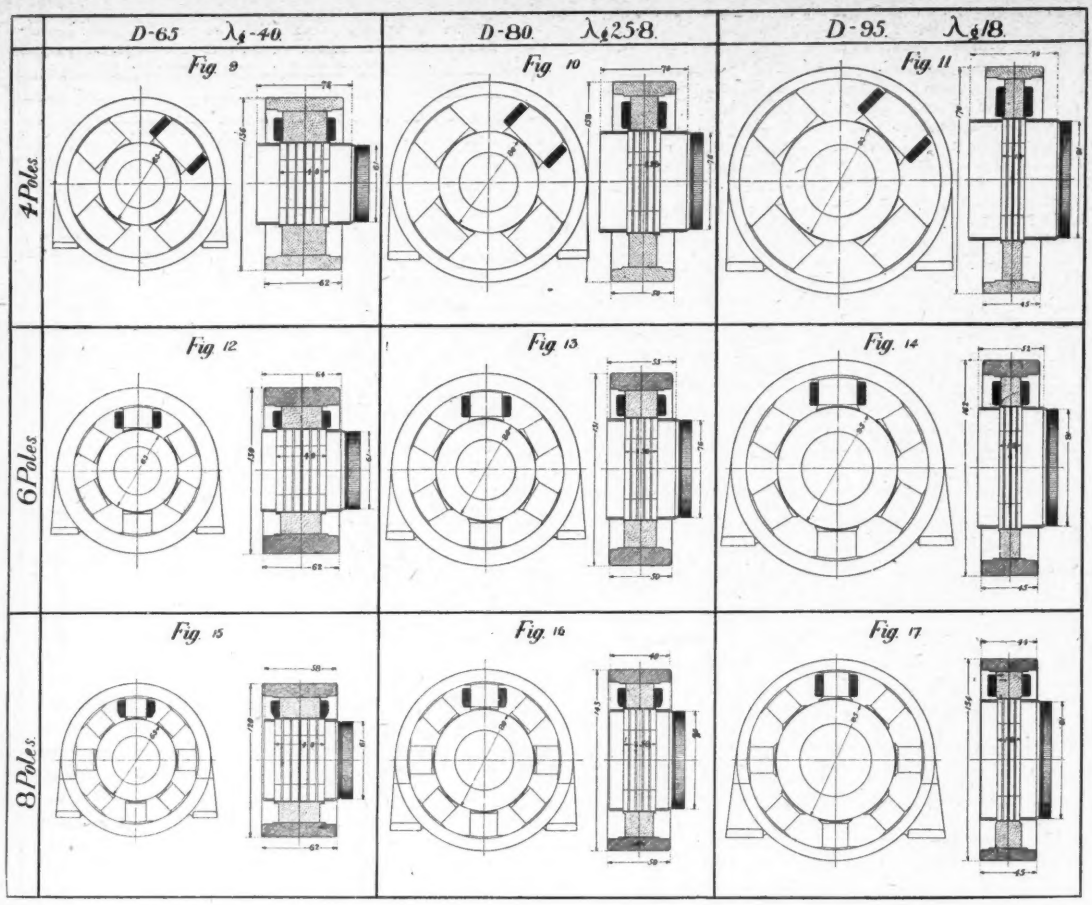
From Table II curves have been plotted in figs. 18 to 25, showing the values of reactance voltage, commercial efficiency, cost of effective material and total works cost in their relation to gap diameter and number of poles. From these curves it is evident that although these designs have the same output coefficient, their technical and commercial constants vary over a wide range.

The total works costs as plotted in the curves of figs. 24 and 25 are estimated by a method which is fully described in "Elementary Principles of Continuous Current Dynamo Design," by H. M. Hobart (Whittaker & Co., 1906), Chapter V. It is sufficient at this point to call attention to the fact that although these nine designs all have the same output coefficient, the design of fig. 11 has a total works cost 56 per cent. higher than the design of fig. 15. In the case of these designs the difference between the T.W.C. of the six and eight-pole machines for the same diameters is not very marked; in the most extreme cases it does not differ more than 8 per cent. The four-pole designs are obviously inferior in every respect, having highest T.W.C., highest reactance voltage, and lowest commercial efficiency.

Having eliminated the four-pole design from further consideration, it depends upon the requirements of the preliminary specification as to which of the six or eight-pole designs will be the most satisfactory. For instance, if especially good commutation be specified, the eight-pole 95 cm. diameter design of fig. 17 should be chosen. For high efficiency one would take the six-pole 65 cm. diameter design of fig. 12.

It is believed that the reader will see from these instances the importance of keeping prominently in mind Dr. Kapp's recommendation that the output coefficient should be regarded as a rough approximation, simply serving to facilitate preliminary trial calculations. Other things being equal, a high output coefficient is desirable, but great care should be taken that the case in hand is one permitting of a high output coefficient.

D



Figs. 9 to 17.—Showing Diagrammatically the Machines Referred to in Table II.

TABLE II.—Various Designs for a 100-kw. 500-Volt 400 r.p.m., Shunt-Wound Continuous-Current Generator, with the Same $D^2 \lambda_g$, but Varying Gap Diameter and Number of Poles.

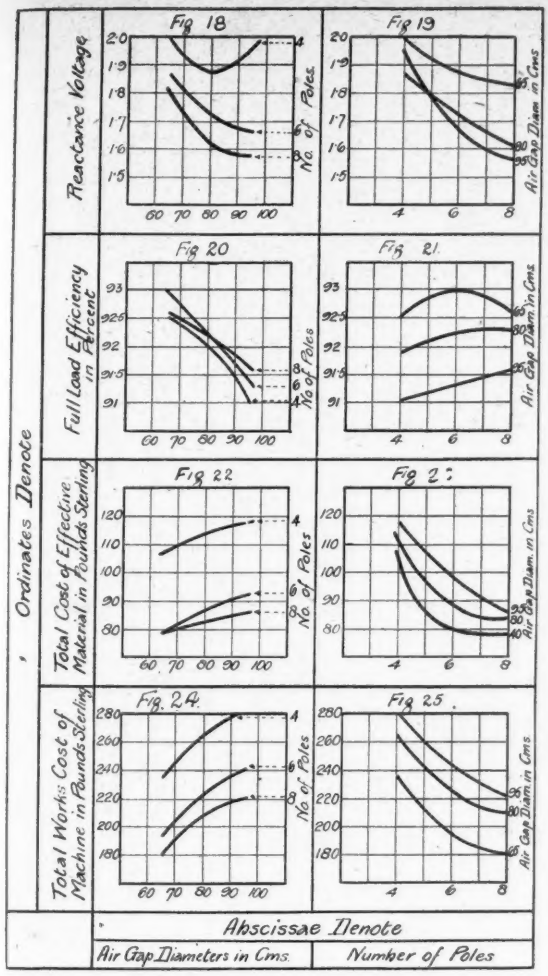
—	Four poles.			Six poles.			Eight poles.		
Armature diameter, D	65	80	95	65	80	95	65	80	95
„ gross length λ_g	39	25·8	18·2	39	25·8	18·2	39	25·8	18·2
Number of slots	80	100	120	80	100	120	80	100	120
Dimensions of slots	2·0×1·25	2·0×1·25	2·0×1·25	2·0×1·25	2·0×1·25	2·0×1·25	2·0×1·25	2·0×1·25	2·0×1·25
„ bare conductors	·65×2	·65×2	·65×2	·65×·117	·65×·117	·65×·117	·65×·075	·65×·075	·65×·075
External diameter of yoke	136	158	170	130	157	162	120	143	154
Material of yoke	CS.	CS.	CS.	CI.	CI.	CI.	CI.	CI.	CI.
Length of air-gap	·4	·5	·6	·4	·5	·6	·4	·5	·6
Commutator diameter	61	76	91	61	76	91	61	76	91
„ length	12	10	8·75	12	10	8·75	12	10	8·75
Number of segments	320	400	480	480	600	700	640	800	960
„ face conductors	640	800	960	960	1,200	1,400	1,280	1,600	1,920
„ turns per pole...	80	100	120	80	100	120	80	100	120
Total current from commutator	200	200	200	200	200	200	200	200	200
Current per circuit...	50	50	50	33·3	33·3	33·3	25	25	25
Armature ampere-turns per pole...	4,000	5,000	6,000	2,660	3,300	4,000	2,000	2,500	3,000
Reactance voltage	2·0	1·86	1·97	1·87	1·71	1·66	1·82	1·6	1·51
Armature watts per sq. dcm.	34	35	35	38	40	42	42	44	47
Commutator „	41	41	41	41	41	41	41	41	41
Field spool „	10·5	10·5	10·5	10·5	10·5	10·5	10·5	10·5	10·5
Full-load efficiency in per cent.	92·5	91·8	91·0	93·0	92·3	91·3	92·6	92·3	91·6
Cost of effective material in £	107	113	117	78	86	91	78	83	86
Total works cost in £	235	265	280	195	225	240	180	210	220

Specific Weight.—The authors, having recently had occasion to estimate roughly the weights of some machines from their general dimensions, and wishing to be able to accomplish this without the laborious process of estimating the different weights of component parts, made an investigation on numerous continuous-current machines with a view to finding a reasonable relation between dimensions and weights. After investigating a large number of machines ranging from 1 kw. up to 2,500 kw. rated capacity, a remarkably close relation between $D^2 \times \lambda\, g$, and the net weight of machine was discovered. In fig. 26 are given curves showing this relation up to values of 400,000 for $D^2 \times \lambda\, g$ in cm., plotted against the "total weight of machine in metric tons." This represents a range of machines at normal speed up to 300 kw. output. In fig. 27 $D^2 \times \lambda\, g$ reaches the value of 20,000,000, and represents machines of normal speed for from 300 kw. to 2,500 kw. output.

For our purpose we shall denote the specific weight ρ of dynamo-electric machinery as the ratio of the weight in kilogrammes to the value of $D^2 \times \lambda\, g$, D and $\lambda\, g$ being expressed in centimetres. Thus—

$$\rho = \frac{\text{weight in tons}}{D^2 \times \lambda\, g}.$$

This varies from 0·008 in the largest machines to 0·03 in



FIGS. 18 TO 25.—SHOWING VALUES OF REACTANCE VOLTAGE, EFFICIENCY AND TOTAL WORKS COST, PLOTTED AGAINST GAP DIAMETER AND NUMBER OF POLES, FROM MACHINES IN TABLE.

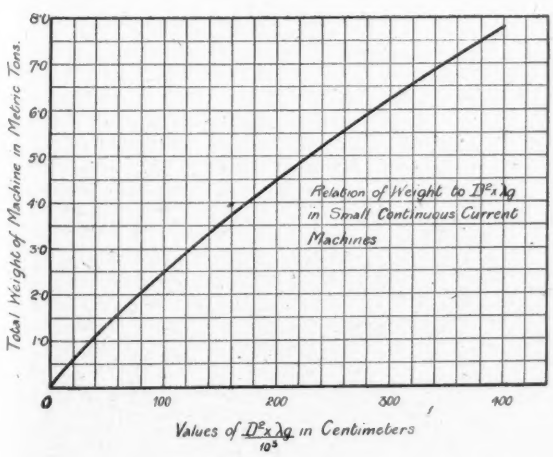

Total Weight of Machine in Metric Tons.
Relation of Weight to D²xλg in Small Continuous Current Machines
Values of D²xλg / 10³ in Centimeters

FIG. 26.

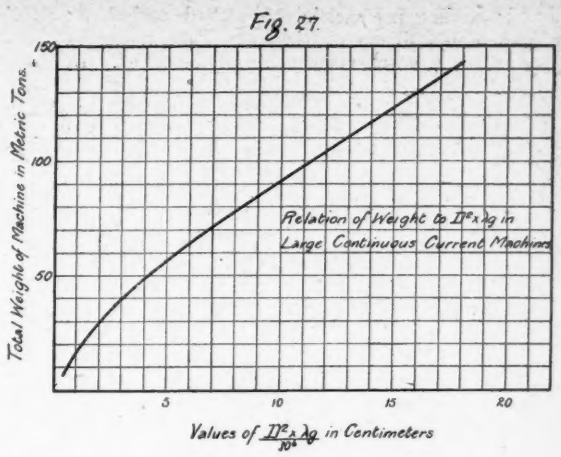


Fig. 27.
Total Weight of Machine in Metric Tons.
Relation of Weight to D²xλg in Large Continuous Current Machines
Values of D²xλg / 10⁴ in Centimeters

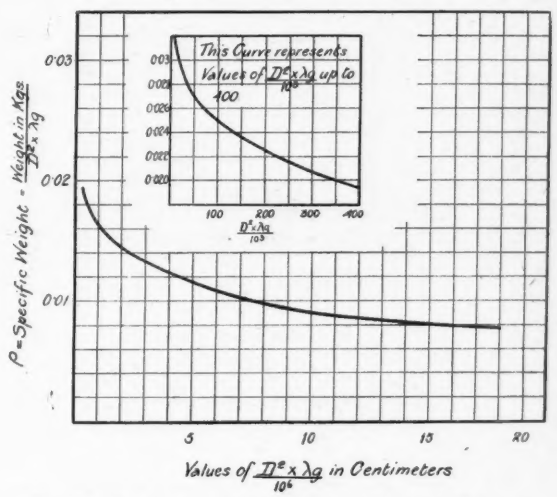
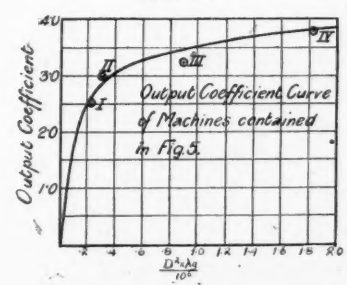

P = Specific Weight = Weight in Kgs / D²xλg
This Curve represents Values of D²xλg up to 100
D²xλg / 10³
Values of D²xλg / 10⁴ in Centimeters

FIG. 28.—CURVES SHOWING VALUES OF SPECIFIC WEIGHT $= \frac{\text{Weight in kg.}}{D^2 \times \lambda g}$.

FIG. 29.



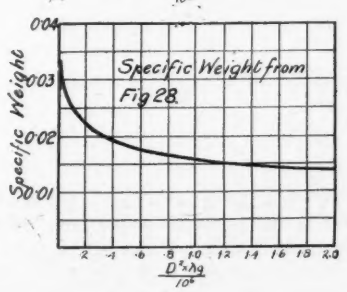


FIG. 30.

the smallest machines. Values for the specific weight are plotted in fig. 28, the small inset curve being for values of $D^2 \times \lambda g$ up to 400,000, and the large curve up to values of 20,000,000.

In fig. 5 the output coefficients for four modern machines were plotted against the gap diameters. In fig. 29 the output coefficient for these machines is plotted against $D^2 \times \lambda g$. In fig. 30 a curve of the specific weight corresponding to fig. 28 is giving, but plotted with values of $D^2 \times \lambda g$ as ordinates to correspond with fig. 29.

The estimations of the total works cost by the method above referred to, although fairly accurate, nevertheless require a certain amount of time. In order to arrive at a rough method for first approximations, the writers have analysed the costs of a large number of machines. The results are shown in fig. 31 with the total works cost in

pounds sterling per metric ton plotted against the total weight of machine in metric tons. Take, for example, the case of the 100-KW. machine already described. Diameter

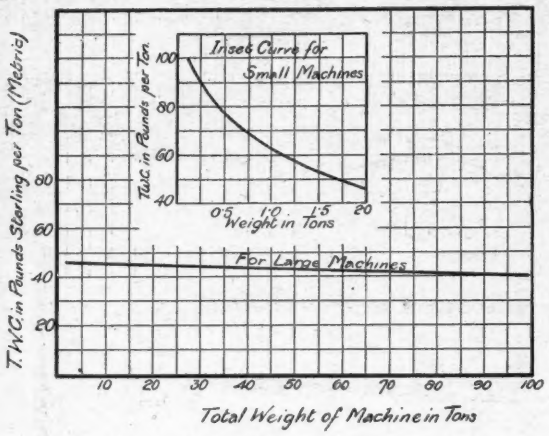


FIG. 31.—TOTAL WORKS COST OF MACHINES IN POUNDS STERLING PER TON WEIGHT.

= 80 cm., gross length = 25·8 cm., $D^2 \times \lambda g = 165{,}000$ cm. From fig. 26 from the value of 165,000 cm. for $D^2 \times \lambda g$, we find a weight of 3·9—or, roughly, 4·0 tons. Referring to fig. 31, this value of 4·0 tons gives a T.W.C. of £46 per ton. Hence the T.W.C. of the machine is about £184.

(To be continued.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Phœnix Electric Heating Apparatus.

The PHŒNIX ELECTRIC HEATING CO., LTD., of 3, Holborn Place, W.C., are just now bringing before the trade a variety of heating and cooking appliances, of which they are the manufacturers. Full

FIG. 1.—ELECTRIC MUFFLE FURNACE.

particulars of these are given in a very fine catalogue, which they have published. It consists of some 104 pages (roughly 6 in. × 9½ in.) bound in stiff bright red covers, and contains illustrations of all kinds of domestic utensils to which electricity has been applied, but electric

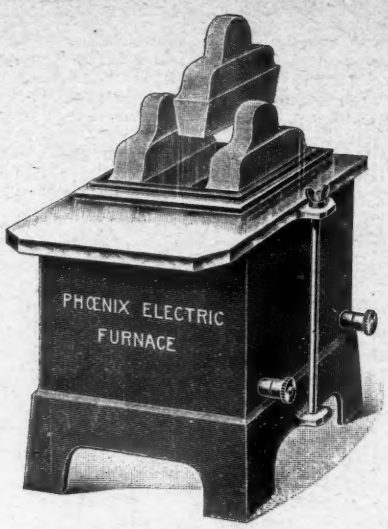


FIG. 2.—ELECTRIC CRUCIBLE FURNACE.

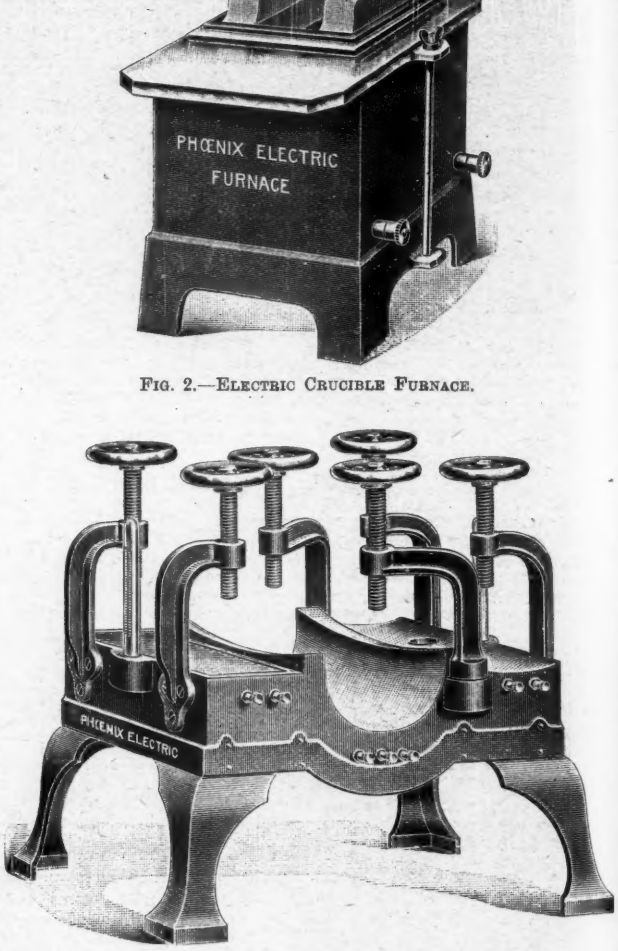


FIG. 3.—ELECTRIC VULCANISER.

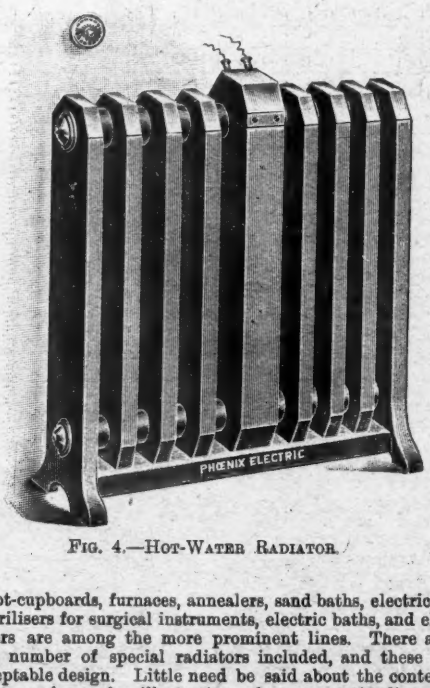


FIG. 4.—HOT-WATER RADIATOR.

ovens, hot-cupboards, furnaces, annealers, sand baths, electric towel rails, sterilisers for surgical instruments, electric baths, and electric vulcanisers are among the more prominent lines. There are, of course, a number of special radiators included, and these are of very acceptable design. Little need be said about the contents of the list, as we show a few illustrations of representative lines which will at once indicate the character of the company's manufactures.

In fig. 1 there appears a Phœnix electric muffle furnace with regulating resistance, for the use of manufacturing chemists, assayers, or for service in workshops. In fig. 2 there is illustrated an electric crucible furnace suitable for melting jewellers' sweepings, for laboratories and for all other purposes where a high temperature is required.

A patent electric vulcaniser is shown in fig. 3, arranged for repairing three tires at the same time. Another vulcaniser is supplied in portable form for carrying on a car for repairing moderate sized punctures.

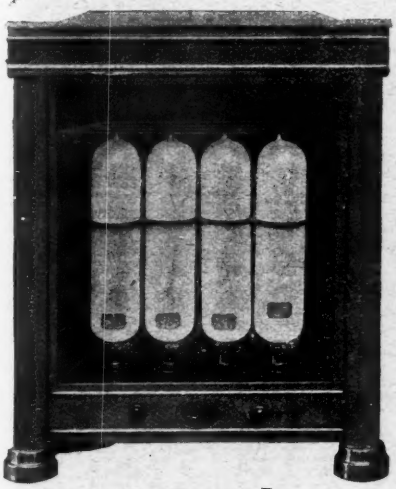
Fig. 4 is one of the Phœnix electric hot-water radiators. When a number of these are placed in the various rooms, each one is independently heated and controlled by a separate switch. The heating is done by means of immersers, one of which is placed in the centre section of the radiator, thereby utilising all of the heat developed by the current. These radiators are supplied in three sizes (24, 30 and 36 in. in height).

Electric Advertising Disk.

We have received from the Illuminated Disk Co., of 59, Cornwall Street, Birmingham, particulars of the device illustrated herewith, and invented by Mr. A. B. Gregson. It will be seen that it consists of a transparent disk which is illuminated by a focus electric lamp, situated at the focus of a parabolic reflector; the flood of light thus obtained brilliantly illuminates the disk, showing up the lettering very clearly. The disk can easily be changed, and can be supplied with any design, coloured or plain. An interrupting device is also employed, by means of which an intermittent flashing effect is obtained. Three sizes are made, with 6, 9 and 12-in. disks. The connection is made with the lighting circuit by means of an ordinary plug and wall-socket.

Dowsing's Electric Radiators.

Important improvements have been made this season in the electric radiators made by the Dowsing Radiant Heat Co., Ltd. The well-known type 422, one of the first introduced and installed in the Royal yacht, has now been made with a flat top which is heated both by radiation from the top of the lamps, and by the hot air rising from the air-heated chamber at the back, and becomes hot enough (about 120° F.) to keep food warm. A further improvement has been made by the addition of an open shelf or grid inside the radiator, just above the lamps, and food placed on this grid can be warmed up to 200° or more. These radiators are, therefore, of great use in the breakfast room or nursery where a double purpose heater of this kind is of great value.



Dowsing New Electric Radiator.

The older type of 422 is still made, but the alteration and addition above referred to only increase the cost of the radiator a few shillings, and of course it costs no more for working. It is simply a plan for using some of the heated air before it escapes into the room.

In some cases these radiators are of great use to jewellers who use the hot top for their drying baths for jewellery, and in other cases where a moderate amount of heat is required, such as for drying letters before posting. They are used in laundries and dye-works for drying delicate fabrics which are, of course, quite unharmed by the heat rays, and dry very quickly.

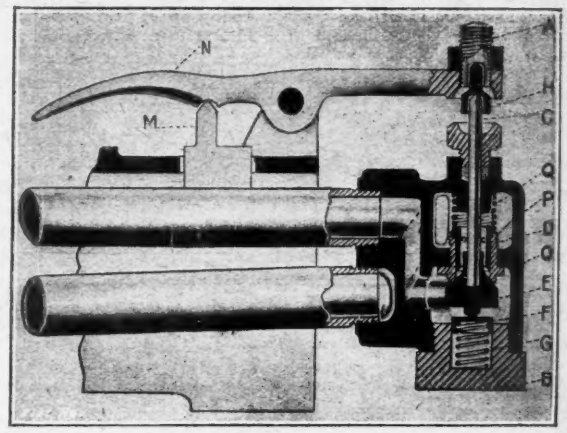
Another type of radiator is made with the top forming a hot cupboard, and although it is merely intended to be used as a warming arrangement, the heat attained (250° F.) is sufficient to cook certain articles of food when a high temperature is not required.

New Steam Trap.

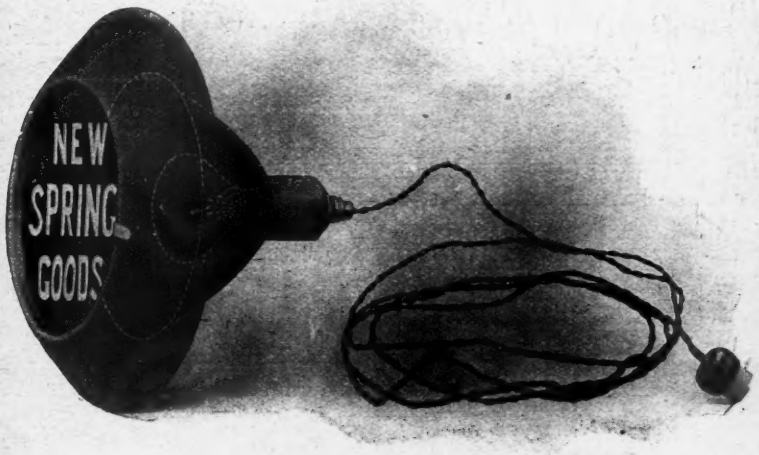
Messrs. Geipel & Lange, of St. Thomas Street, S.E., are about to introduce a new patent rapidity type steam trap, which they claim to be greatly superior to the ordinary steam trap.

The rapidity of the discharge, the sharp and definite shutting of the valve when all water has been discharged, and the rotating and self-grinding valve are its features, in addition to which it has the well-known multiplication of expansion without the use of levers, and the hand-blow-through as well as the other advantages common to the ordinary Geipel trap.

The valve is re-arranged in such a way that it is held on its seat by the steam pressure; consequently a valve of much larger area can be used than in the ordinary trap, where the valve is closed against steam pressure. The valve is of the rotating type, so that every time a discharge takes place the valve tends to grind itself in. The action of the valve is such that, when blowing through, it is forced well off its seat to give the maximum opening. In order to obviate the noise, straining and cutting of the rapid discharge which results from the large opening through which the water is forced under high pressure, there is provided an arrangement which automatically reduces the velocity of the water; this throttle comes into action under high pressures, but not under low pressures. The trap gives a full-bore discharge whether the pressure is low or high, without causing undue noise or destruction at high pressure. The usual Geipel hand-blow-through is provided, and the valve can be got out for inspection and cleaning by simply removing the valve cover, without interfering with steam connections or other parts of the trap. It will work without readjustment under considerably greater ranges of pressure than the ordinary Geipel trap, and the loss by radiation is less.



Geipel Rapidity Type Steam Trap.



Illuminated Advertising Disk.

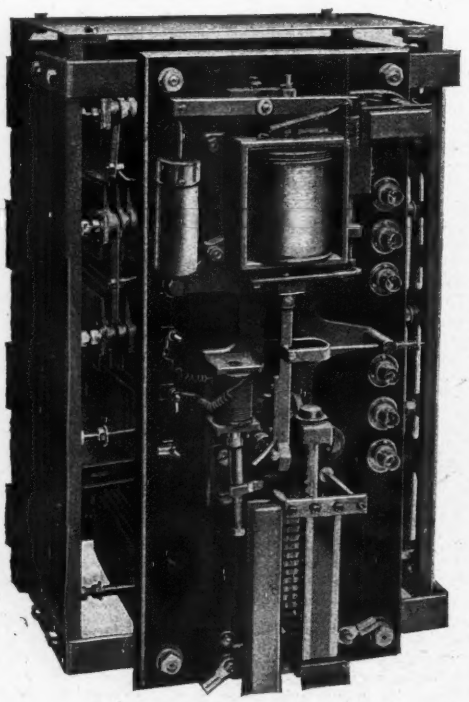
The brass tube, which constitutes the inlet and should be connected to the vessel to be drained, is at the top of the trap. The iron tube which constitutes the outlet for the discharge is at the bottom. This arrangement is the converse of the ordinary Geipel trap, and makes a more convenient disposition for the inlet and outlet. The two tubes are fixed at one end as heretofore, and are free to move at the opposite end, where the valve is fixed.

The valve E is held normally on its seat by the steam pressure combined with the pressure of a light spring G. When the trap is cold or full of water, the valve is depressed from its seat by the valve spindle C, which abuts against the end of the lever N. When steam enters the brass tube the latter expands and moves the valve casing O downwards. The steam pressure and light spring then close and hold the valve tight until water has again entered the brass tube and cooled it, upon which the brass tube contracts and moves the valve casing upwards until the valve spindle C impinges on the lever and forces the valve open. As soon as the valve is

open the rush of water, so to speak, forces or wedges the valve downwards, thus making the large opening which gives the rapid discharge. So rapid is the discharge, that the automatic throttling device above referred to has been found desirable at high pressures, in order to avoid shock, strains and noise. This device consists of a movable bush P, controlled by a spring Q; its action is automatic, so that when the trap is discharging at low pressure, as, for example, when steam is first turned on, the bush does not tend to throttle, but when the pressure rises and there is an increased discharge, the friction thereof moves the bush in an upward direction against the action of the spring, thus reducing the aperture of the discharge and consequently its velocity. With this automatic device the trap discharges rapidly whether it is working under high or low pressure. The valve E is separate from the valve spindle, and is therefore not held fast by the friction of the stuffing box; further, being provided with vanes, it is caused to rotate whilst discharging, and consequently to grind itself in at each discharge so that the seat is kept in good order. There is no dribbling, but as soon as the trap commences to discharge the valve is forced well open; a sharp blow-through then occurs until all water is discharged, when the trap is as suddenly shut. The facility for removing or renewing the valve and seat which is provided in the old type has been retained in the new type.

Circuit-breakers and Starting Switches.

Messrs. Bertram Thomas, of Worsley Street, Hulme, Manchester, manufacture a line of circuit-breakers, some noteworthy features of which are the massive construction of all parts, the use of a powerful magnetic blow-out combined with an unusually wide break and a catch of ample projections, and made throughout of tool steel hardened and tempered where necessary. The coil is cut from solid copper, the brush is of quite special design, the auxiliary contacts are in triplicate and of metal, so that they cannot break, and the working forces are extra large, so as to give a big margin of safety. The reverse current breakers operate by what is essentially a small motor, and no excess of reverse current can do anything but increase the force of operation. Time limit and no-load



Bertram Thomas Automatic Starter.

devices are applied where required. We are informed that these breakers have been supplied for numerous repeat orders for some of the heaviest traction schemes in the country. Some circuit-breakers up to 6,000 amperes with time limit have been recently supplied to one of the largest railway companies for an electrification scheme. Among the firm's specialities is also a starting switch giving a ratchet action combined with a double-pole circuit breaker, all operated by the one handle. The first movement of the handle sets the breaker. Further movements rack up the starting arm till all resistance is cut out. During this or any subsequent period, if an overload comes on, the circuit-breaker is free to open, and the whole operation must be repeated. In the accompanying figure we show an automatic starter suitable for all capacities from 30 H.P. up to 1,000 H.P., the actual illustration being a photograph of a smaller size up to 100 H.P. at 500 volts. Most efficient precautions are taken to protect the working contacts. These starters are used for air compressor plants, hydraulic pumping plants with accumulators, or simply for starting ordinary motors, say at a distance or where the attention is very unskilled. Limit switches and solenoid switches, single or double-pole, are supplied to suit varying circumstances, together with automatic field regulators to vary the speed of the motor automatically. All kinds of other starting and field regulating gear are made by this firm, and they also supply a street lantern of the shadowless type for incandescent electric lighting, for which they claim simplicity, cheapness and well-proportioned design.

Hanby Watt-hour Meter.

This meter has been placed on the market by the Union Electric Co., Ltd., of Park Street, Southwark, S.E., for use on single and polyphase circuits. It works on the principle of a commutatorless split-phase motor, and consists of a metallic disk in a

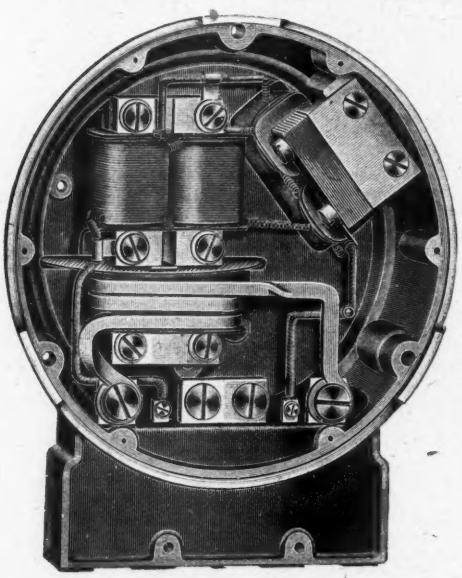


Fig. 1.—Back View of Hanby Meter.

rotating field, produced by a series and a shunt-winding, giving a torque proportional to the power supplied to the circuit. The accompanying figures show the front and back of the meter. The mechanism is carried on a cast-iron baseplate; there is a laminated-core shunt-wound magnet, with resistance coils in series, above the aluminium disk, and a similar magnet wound with a

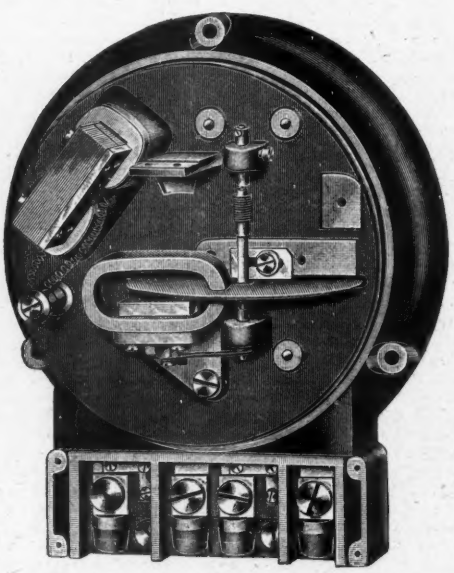


Fig. 2.—Front View of Meter, counting Train Removed.

series coil embracing both legs below it, facing the former. The spindle and bearings of the disk are on the front of the baseplate, where also is fixed the brake magnet, which is well seasoned, and is shielded by the baseplate from the action of the electro-magnets and conductors. The spindle is tubular, and has at the lower end a ball-shaped pivot, running in a spring-supported sapphire jewel; the upper end of the spindle is guided by an internal steel wire. Thanks to this method of mounting, no special provision for transport is necessary. The meter cannot creep. The current-carrying parts are insulated to withstand 1,000 volts to earth, and the enclosure is dust-proof. The

hands of the dials all revolve in the same direction, thus simplifying reading. The power consumed by the shunt circuit is from 1½ to 2 watts, and the main circuit at full load consumes from 1·2 to 1·5 watts; the accuracy claimed is within 3 per cent. from $\frac{1}{10}$ to full load, and the meter starts with 1 per cent. of the full load. The accuracy of working is not appreciably affected by inductance in the circuit, or by varying voltage or frequency over a very wide range. The terminals are embedded in insulating material, and provision is made for sealing the terminal box and the case.

NEW SOUTH WALES TRAMWAYS.

A Comparison of Electric *v.* Steam.

Some of the Sydney tramways cost £61,000 per mile to construct, and yet the Railway Commissioners manage to earn a net profit of 5·99 per cent. on them without raising an outcry from the public as to excessive fares. In the report just issued relating to the New South Wales Railways and Tramways for the year ended June 30th, 1906, the Commissioners give the total number of miles open as 126, and the amount spent on construction and equipment as £3,669,096. This total includes about 40 miles of steam and horse tramways, but as these are more or less unprofitable, their inclusion in the total only makes the case for the efficient working of the electric tramway stronger still.

The steam tramways may be disposed of by enumerating that the Newcastle and Brokenhill lines return a profit of £2 7s. 8d. and £2·42 per cent. on the capital invested (£322,298 and £59,336 respectively), the percentage of working cost to revenue being 87·30 in the former and 89·66 in the latter case.

The other three steam lines each show a loss, the percentage of working cost to revenue being 112·34, 122·43 and 142·37. The only horse tram in existence shows a loss, the percentage of working cost to revenue being actually 150·19.

The bulk of the capital is invested in two electric lines, one of a length of 73 miles 57 chains, or 123 miles and 20 chains of single track, and the other of 11 miles 68 chains, or 15 miles 72 chains of single track. The first is the City and Suburban, which has cost in construction and equipment, up to the date of the report, a total sum of £2,966,704. The gross revenue last year amounted to £730,508, working expenses came to £552,723, leaving £177,785 profit, or £5 19s. 10d. per cent. on the capital invested. Compared with the previous year this is a phenomenal advance. In 1905 the takings amounted to £697,971, the working expenses to £585,360, and the profit to £3 18s. 2d. per cent.

On the other electric line, which is on the north shore, divided from the main city by the width of the harbour, the figures are not so good, the suburb being not so well settled as that of the city proper. The total cost of production was £293,232, the revenue amounted to £52,109, with working expenses at £45,230. This left only £6,879 for profit, or £2 6s. 11d. The percentage of working cost to revenue works out at 86·80 against 75·66 on the city and suburban lines; the previous year, however, the profit was £3 5s. 5d. per cent. or a percentage of 80·43. The total result of the Government's tramways, including the unproductive lines already enumerated, is as follows:—Total earnings for the 12 months 1905-6, £851,483; expenditure, £665,083;* interest on capital, £130,440; surplus, £55,960. Compared with a deficiency of £1,619 last year owing to reconstruction of lines, this, it must be admitted, is a splendid result. During the year 45 new electric bogie motor-cars and four motor-'buses were added to stock, and eight cable trailer cars were converted to electric trailers. A sum of £22,574 was charged to working expenses on account of 13 old steam motors, eight cable trailers, and 19 grip cars written off the books. Since the introduction of electric working, the old steam and cable stock to a large extent either became renewed by electric cars or by writing down the capital and by debiting "working expenses," a sum of £151,353 having been so dealt with on account of 158 steam cars, 53 steam motors, 21 cable trail cars, 21 grip cars and six electric motor-cars of an obsolete type. The electric rolling stock includes 684 motor-cars and 51 trailers. A sum of £5,000 was written off in 1904-5, and further £20,000 in 1905-6 in connection with the North Shore and Ocean Street cable plants and conduits, &c., not required since the introduction of electric working. Four steam motor-'buses were acquired, and the service was discontinued after four months. The total cost of equipment was £5,331, and the revenue fell short of £1,344 of the expenses, not counting the sum of £109 required for interest on the capital expended.

After all these drawbacks we arrive at an average of £5 1s. 7d. per cent. net profit as compared with the £1 19s. 7d. of the old steam and cable days. The average percentage of working expenses to earnings was then 92·67, this year it is 78·11. There is little difference in the earnings per mile open. In 1888 it was £6,224, in 1905-6 it was £6,758, yet the return per mile open has risen in the intervening period from £455 to £1,479. The earnings per tram mile in the steam and cable period, say, in 1888, was 3s. 4¾d.; it is now only 1s. 0½d. The working expenses, however, have dropped from 3s. 1½d. per mile to 9¾d. There is a return, after paying working expenses of 2⅝d. per tram mile against 3d. in 1888. This 3d. was multiplied with 1,388,736 tram miles against 2⅝d. × 16,309,907 in the year under review. The number of passengers carried in the old days can only be guessed on account of the peculiar way in which tickets were sold. Last year 145,262,779 passengers were carried as against 139,669,459 in the preceding year. The Commissioners give the following interesting details with regard to the main or city and suburban electric tramways for the last year, and we append the comparative figures for the previous year in brackets:—Length of line 73¾ miles mostly double track, number of passenger fares collected 125,756,680 (120,973,934); tram mileage, 14,246,845 (14,413,273); total earnings, £730,508 (£697,971); working expenses £552,723 (£583,360); † Earnings per tram mile 12·31d. (11·62d.); working cost per tram mile, 9·31d. (9·71d.); percentage of working cost to gross earning, 75·66 (83·59); net earnings, £177,785 (£114,611); capital expended on lines open, £2,966,704 (£2,931,583); interest on capital invested, 5·99 per cent. (3·91 per cent.).

All these tramways are served from a central station at Ultimo.§ The output during the year amounted to 36,137,122 kw.-hours, of which the alternate current supply was 21,188,712 kw.-hours, and the direct current 14,948,405 kw.-hours; of the total output 32,315,754 kw.-hours were required in connection with tramway traction and the balance for other services. Although the output is 2,581,235 kw.-hours in excess of that of the preceding year, a considerable reduction in expenditure has been effected by the introduction of improved methods of fuel consumption (see † and ‡).

In conclusion, it must be borne in mind that these tramways are State-owned, are saddled with a heavy rate of interest, and have no competition of any kind whatever. Their primary object is not to earn a profit, but to serve the needs of the people, and lines have been constructed where required, one may say, regardless of the primary outlay required. Thus, the Ocean Street line, with its heavy gradient, cost £151,241 for 2 m. 38 ch. 50 l., and the 1 m. 63 ch., from the Railway to Bridge Street, £101,860. The cheapest electric line to construct was a stretch of 3 m. 48 ch. (Little Bay), which works out at £5,649 per mile. The total average cost per mile, including steam lines, which are, of course, cheaper to construct, is £16,116.

German Exports of Machinery. — The *Zeitschrift für Elektrotechnik und Maschinenbau* has published a thoughtful article from the pen of Dr. Hermann Röder on Germany's machinery export trade, and its situation in particular with regard to that of its two great rivals, England and America. Comparing the total exports from England and Germany in 1903 and 1904, it shows that whereas the exports from this country increased at the rate of only 1 per cent., those of Germany advanced to the extent of 7·5 per cent., Germany's exports in the latter year totalling 319,200,000 marks, while those of the United Kingdom amounted to 623,700,000 marks. This satisfactory progression, however, justified no relaxation of German manufacturers' striving after superiority in design or execution, as their progress in America's shipments of machinery to Germany showed. In 1894 the value of American machinery exports to Germany totalled only 2,261,000 marks, but in 1900 they had risen to 40,359,000 marks. Since then they had, however, sunk to about one-half, owing, according to the American Consul in Berlin, to his countrymen's neglect of the oversea trade. The declension affected equally most lines of machinery, agricultural sinking from 23,786,000 marks in 1900 to 7,648,000 marks in 1904; machine tools, &c., in the same period fell from 5,041,000 marks to 1,703,000 marks; lifting machinery, 514,000 marks to 100,000 marks; electrical machinery, 506,000 marks to 183,000 marks, and other machinery, 3,733,000 marks to 1,796,000 marks. Typewriters and cash registers alone improved their position, advancing from 1,953,000 marks to 1,980,000 marks. The prosperity of America's home trade in the years 1902-3 was, according to the American Consul, the cause of this declension in the States' exports to Germany, and he appositely remarks that in an old and highly developed land like Germany foreign trade depends in a high degree on the energy and skill of the exporter and his agents. While many American firms only half-heartedly or indifferently cultivate oversea trade, and take no pains to propitiate the customer with translated price lists or easy terms, the majority are as conspicuous for the opposite qualities and methods, and as no public in Europe surpass the German as unprejudiced admirers and willing purchasers of whatever is excellent in oversea productions, the trade is there for whoever goes about to secure it in a rational manner. The judiciousness of these observations cannot be gainsaid, and should commend themselves to the notice of English manufacturers also.

* Including £467,861 for wages, distributed as follows:—Traffic branch, £269,890; electric, £131,618; maintenance, £66,353.

† Detailed as follows:—Maintenance of permanent way and structures, £99,832 9s. 9d. (£92,490 8s. 6d.); maintenance of plant, £124,220 8s. 7d. (£140,393 15s. 4d.); power expenses, £44,333 4s. 5d. (£64,553 16s. 9d.); traffic expenses, £272,346 4s. 9d. (£271,076 18s. 4d.); compensation, £7,077 6s. 5d. (£10,131 16s. 4d.); general charges, £5,213 5s. 7d. (£4,707 16s. 6d.)

‡ Coal, coke and wood cost £23,535, against £30,500; water, £2,552 (£2,856) and lubricants and waste £1,789 (£2,600).

§ The assets are given as follows:

Power house sub-stations and plant	£714,153
Rolling stock, including 42 service cars ...	762,987
Machinery	68,606
Workshops	88,382
Furniture	2,392
	£1,636,620

BREAKDOWNS OF MACHINERY IN 1905.

The annual report of Mr. Michael Longridge, M.Inst.C.E., chief engineer to the British Engine, Boiler and Electrical Insurance Co., Ltd., is always interesting and instructive. From it we learn that in 1905, the rate of breakdown of steam engines insured with the company was higher than usual—1 in 8·3—perhaps due to overloading in consequence of the activity in the cotton industry. Amongst the typical examples of breakdown given is one relating to a 100-kw. steam turbine, in which the runaway valve was found broken to pieces; in a sister turbine the valve was found to be in the same condition. A peculiar case of breakdown due to water in the cylinder occurred in connection with a barometric condenser; it was found by trial that the condensing water, which entered the condenser through an annular valve, was forced also over the upper edge of the valve and sprayed into the exhaust pipe.

It is interesting to note that the rate of breakdown among gas engines in 1905 was lower than in the previous year, and decidedly lower than in the case of steam engines; but the chief engineer considers that this is probably due to the small size of the gas engines insured, and that if the comparison were made with small steam engines only, the inequality would disappear or even be reversed. It is suggested that all cylinders be made with cleaning doors, and that ample provision be made for cooling, the cooling tanks supplied being often inadequate. Fractures of bolts in the big ends of connecting rods are unduly frequent. Mr. Longridge gives examples of their breakage, and points out that it is quite a mistake to suppose that these bolts have nothing to do. Stronger bolts should be fitted, or the marine type of big end discarded in favour of one of the types adopted by locomotive engineers. The third bearing for the crankshaft, and single fly-wheels, are regarded as largely to blame for shaft failures.

A puzzling case of breakdown of a Diesel oil engine shaft was eventually traced to the defective quality of the steel, which was not of British manufacture. A brake test on a 120-b.h.p. engine, without any provision for cooling the rim, resulted in the explosion of the fly-wheel; this conveys an important warning. An engine which had been running for three months with town gas refused to start, and it was found that the exhaust pipe was choked with deposit—a curious occurrence, having regard to the kind of gas used.

Turning to electrical machinery, the insurances effected increased by 16·7 per cent., but the number of breakdowns increased by 32·8 per cent., and the amount paid in claims by 28·5 per cent. This is ascribed to the deterioration of electrical machinery by age and use, as well as to the heavier starting currents now customary. One motor in eight insured broke down during the year; the d.c. motor rate exceeded the a.c. rate by 40 per cent., but the a.c. generator rate exceeded that of d.c. generators by 29 per cent. Half the failures occur to armatures and rotors, and half the remainder to commutators and brush gear. Hardly any failures were traced to overloading; age and deterioration, bad workmanship and design, about equally shared 43 per cent. of the breakdowns. Mr. Longridge describes no fewer than 25 examples of electrical failures. One of these illustrates the danger of excessive speed being attained in the case of a double-wound armature d.c. transformer with series starting coils. Another relates to a dynamo in a foundry, the armature of which became so full of black dust that the conductors were thoroughly short-circuited. Oil and dust similarly destroyed the stator of a three-phase motor, and the author takes occasion to point out that a.c. stators are very liable to damage in this way—no less than 23 per cent. of the failures of a.c. motors in 1905 being traceable to this cause. The metal caps of carbon brushes sometimes are allowed by neglect to come into contact with the commutator, with disastrous results, and the ring lubrication, which requires so little attention, frequently receives none at all, with the result of damage to the bearings, and possibly to the armature. The oil wells should be fitted with gauge glasses, and the drain-cocks should have removable handles, so that they cannot be turned on by accident. Shields over the ends of armatures are objected to as dirt traps. The small clearances of a.c. motors necessitate careful attention to the bearings and frequent gauging of the clearance. Many makers, it is said, give insufficient attention to the protection of conductors at the edges of the armature core and of the winding drums. The breaking of shunt circuits frequently results in damage to the insulation of field coils and the no-volt release coils of starting switches. This should be avoided by connecting the shunt winding in such a way that it is always left closed upon the armature and starting resistance.

Micanite is unsatisfactory for use between commutator segments, leading to short-circuiting by carbon dust. Pure mica should be used. A better material is also desirable for the end insulation of commutators, but it is difficult to suggest a substitute. The percentage of breakdowns of motor commutators due to the use of compressed mica was in 1905 no less than 63; but no failures of dynamo commutators were attibutable to this cause. Mr. Longridge suggests that one reason for the difference may be the fact that many motors are supplied from three-wire systems with the middle wire earthed, so that the insulation has to withstand only half the supply voltage; but, surely, this fact tells in the reverse sense.

Often armature cores and commutators are badly made and insecurely fixed to the shaft; this is one of the points which are commended to the attention of manufacturers.

Several accidents occurred through the screws holding pole-shoes in place becoming slack, and allowing the shoes to touch the armatures. As a rule, these screws are entirely unlocked, and the Chief Engineer thinks that the heads should be riveted over to prevent them from slackening. Binding wires on armatures often break without obvious cause.

Regarding the insurance of boilers, the company is still able to state, with just pride, that no life has yet been lost through the explosion of a boiler certified by it. Corrosion and grooving account for the great bulk of the defects reported, and fractures for most of the remainder. Some extraordinary examples come under the company's observation, the inspector's chisel sometimes going through the plates whilst scraping them. The examples given are of little interest to electrical men. The report concludes with a summary of the Board of Trade reports on boiler explosions, &c., for 1905. These include several cases of water-hammer due to bad drainage of steam pipes, cast-iron valves figuring frequently in the reports.

We have but briefly indicated the nature of the contents of Mr. Longridge's report; there is very much information in it of value to manufacturers and users of steam and gas plant and electrical machinery, and by studyng this in the original, few designers would fail to find some hints for the improvement of their designs.

LEGAL.

Hunt *v.* Green.

This case, which came before a Divisional Court of King's Bench composed of the Lord Chief Justice and Justices Ridley and Darling on Wednesday last week, raised an important point under the by-laws of tramway companies. The case came before the Court by way of a case stated by the Justices of the city of Norwich.

The material facts were these. The respondent on May 15th, 1906, was a passenger on a tramcar belonging to the Norwich Electric Tramway Co., which carried on its business under statutory powers, the appellant being a ticket inspector of the company. The respondent was charged before the Justices by the appellant for refusing when asked to do so either to deliver up his ticket or pay the legal fare demandable for the distance he had travelled as a passenger. It was admitted that respondent had paid his fare, 1d., soon after the car started and received a ticket, and that during the journey the car became over full of passengers, and that the respondent complained of this, and gave up his seat to a lady. The appellant entered the car to inspect tickets, and asked the respondent to produce his ticket. The respondent complained to him that the car was overcrowded, that he had changed his seat, and that he could not find his ticket. The conductor was called, and said that the respondent had paid his fare, and an unsuccessful search for the ticket was made. Appellant then said to the respondent, "You must produce your ticket or pay the fare," but this he refused to do. The car was then stopped, and the appellant said to the respondent, "produce your ticket, pay your fare or leave the car." As the respondent refused to do so, and completed the journey, the appellant laid the information. The by-law under which the charge was made, ran as follows:—"Each passenger shall show his ticket (if any) when required so to do, to the conductor or any duly authorised servant of the company, and shall also when required to do so either deliver up his ticket or pay the fare legally demandable for the distance travelled over by such passenger." The Justices found as a fact that the appellant had not in so many words asked respondent to deliver up his ticket in the words of the by-law and dismissed the information. Hence the present appeal.

Mr. Cecil Walsh appeared for the appellant and Mr. Scott for the respondent.

At the conclusion of the arguments of Counsel their Lordships held that the case came within the by-law in question notwithstanding that its exact words had not been used by the inspector, and they sent the case back to the Justices for further consideration, but not necessarily with an instruction that they ought to convict, because they thought it was exactly one of those cases where they could exercise their discretion and inflict no penalty.

The appeal was accordingly allowed with costs.

Resistance of Electrolytes to Currents of High Frequency.—Some measurements have been made by Broca and Turchini of the resistivities of acidified water and of copper sulphate solution when alternating currents of high frequencies are passed through them, comparative experiments being carried out simultaneously with alternating currents of ordinary frequencies and with direct currents of the same strengths. The electrolytes were held in cylindrical tubes 6 cm. in diameter and 10 cm. long, stout plates of platinum serving as electrodes. The tubes were fitted with capillaries at their sides, into which the liquids entered, and the heights of the liquids in the said capillaries served to indicate the extent to which they had been heated. It was found that the resistivities to currents of high frequency were smaller than to ordinary alternating currents or to direct currents. When a 10 per cent. acid was tested with a current having the frequency of 3×10^6 cycles per second, the resistance was only 77 per cent. of what it was in other cases. The resistance decreased as the frequency and the conductivity of the electrolyte increased.

CORRESPONDENCE.

Letters received by us after **5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Alternating Current Networks; and the Absorption of Hertzian Waves.

On page 727 of your last issue I notice a report of a paper on this subject.

The author says: "The surges caused by harmonic resonance . . . . happen only on networks of small extent." Surely one would think that as the natural period of oscillation of a system came down, the possibility of harmonic resonance occurring was increased, though, of course, there is more chance of the disturbance being absorbed by the various loads. One doubts, too, his recommendation "of checking their effects by safety fuses."

As regards the switching-in of a dead line, I have been looking for the last five years for a decent mathematical treatment of this particular point.

Mr. Woodhouse discussed the matter shortly in the *Electrician* of September 5th, 1902, using the Helmholtz formula $E_1 = \frac{L\,R}{\frac{RT}{L}}$ to obtain the pressure rise at the moment of switching. But this formula certainly cannot be applied here in this way, and so Mr. Woodhouse wrongly obtained the double instantaneous pressure as the maximum possible, without pre-supposing the "cumulative circumstances" mentioned in your report.

I may say that with "cumulative circumstances" more than double pressure (*i.e.*, more than $2 \times \sqrt{2}$ virtual) has been observed in this connection.

Can you or your readers discuss this switching-in business?

There is a point in Mr. J. S. Dow's article in the same issue on "The Absorption of the Atmosphere for Light of Different Wave Lengths."

He says "a solution of alum is almost completely impervious to infra-red rays," and "Hertzian waves are now known to be light waves of long wave length." Is it a correct inference to draw, that if Hertzian waves were propagated in a room surrounded by a layer of alum solution, they would be completely stopped?

E. Hudson.

Preston, *November 5th*, 1906.

The Penetrating Properties of the Arc Light.

There is no need for me to say much more on this subject now that it has been so lucidly dealt with by Mr. Dow in your issue of November 2nd. However, Mr. Bastian still misunderstands—and I can only believe wilfully—the theory I supported in my former letters. He, of course, is ignoring the difference between reflected and transmitted light. The former will certainly increase as the number of particles increases, but the latter will correspondingly decrease since the total, apart from what is absorbed by the particles themselves, is constant. Thus the atmosphere becomes less transparent the more particles it contains.

Lastly, Mr. Bastian has not yet explained why distant objects while appearing blue to the eye come out much too light in a photograph. If the blue colour is due to absorption of red rays by the intervening atmosphere, these red rays must have a negative actinic effect on the sensitive film, since their absence increases the effect. This is rather a startling result to arrive at. Will Mr. Bastian please inform us on this point?

Sol.

York, *November 5th*, 1906.

Bullock Motor Control System.

I have charge of five sets of the Bullock system of motor-control for rotary printing presses (60 H.P.), and not having any clear diagrams, &c., I would be very much obliged if you or any of your readers could give me the following information:—

1. A diagram with teaser and controller connections.
2. (*a*) Is the motor a differential motor; or (*b*) is the armature circuit on the slow speed supplied with current at a low voltage from teaser, and on the high speed with current at supply pressure?
3. Assuming the second half of question 2 is correct, does the shunt circuit come into action on the slow speed, or does the machine act as a series motor?
4. Does the shunt regulating resistance that comes into play along with the high speed, remain in circuit with full resistance in on slow motion, and then cut out gradually after resistance of armature circuit is fully cut out?

I would be glad of any information, however little, to enable me to understand the working of the plant.

Bullock.

Nernst Lamp Renewals.

We note the remarks made by Mr. W. A. Walton in his letter published by you last week.

The reason for the extraordinarily low average life he obtained is clearly the fact that the cut-outs of these lamps were faulty. If these coils had been renewed, no more than the normal number of burners would have been required. We regret to say that the insulation of the cut-outs in a number of lamps supplied by us about a year ago was defective and caused the heating coils of the burners to fail after, in many cases, only 20 or 30 hours' use.

It is to be regretted that Mr. Walton did not inform us or our agents of the matter in time. If he had, we would have remedied the defects at once and saved both him and his clients much expense and annoyance.

Where contractors and users of our lamps experience similar trouble they would oblige us by communicating with us, so that we can take steps to remove the cause. In the case of large installations we are quite prepared, if necessary, to send a specially trained man to attend to the lamps and to instruct the fitters on the spot.

The A.E.G. English Manufacturing Co., Ltd.,
PATENTEES OF NERNST LAMPS.

London, W.C., *November 5th*, 1906.

P.S.—Will users of Nernst lamps kindly note that we are always pleased to remedy any defects which may arise, due to faulty manufacture, and to place our experience at their disposal?

Wear of Rails.

On several occasions recently I have noticed the statement that the wear of rails on the up line of a grade is heavier than the wear on the down line, and I am led to think that the explanation of at least part of this difference in wear may be found in much the same causes as those to which I have attributed the difference in wear between trolley wires which constantly supply current to cars, and trolley wires which supply little or no current.

Robert N. Tweedy.

Stourbridge, *November 2nd*, 1906.

Rail Corrugation.

I have been interested in the explanation given by Mr. Boot as to his idea of the probable causes of the phenomena of rail corrugation, and must say that it is by no means convincing. With regard to their occurrence on steam railways, he first doubts their existence, and then ascribes the cause to another theory.

The fact that there is sparking between wheel and rail in the case of an electric tramcar is no proof that that is the cause—although I quite agree that flashing does not improve the rail condition—and I venture to suggest that there is still considerable doubt in the matter.

Mr. Boot is "somewhat at sea" in the electrical ideas as set forth in his letters. There is a complete circuit just as much in a regenerative system with an overhead conductor as when the same system is absorbing power by means of the motor. Energy does not pass round a dynamo, but the direction of the current, as understood "conventionally," is reversed when a dynamo acts as a motor.

M

I agree that Mr. Coxon overlooks the fact that when regeneration is taking place there is sparking between wheels and rails, and that the sparking is even more severe than when running on the level, depending entirely upon the amount of current passing. This, however, does not dispose of the question, as it is well known that corrugations are neither limited to tramway gradients nor even to tram rails.

Doubtful.

London, S.E., *November 5th*, 1906.

With reference to Mr. Horace Boot's letter *re* "Rail Corrugation" in your last issue, if Mr. Boot will visit Sunderland, I shall be pleased to show him several instances of corrugation "taking place downhill where the regenerative control system is not in use, and where the energy is shut off."

A. R. Dayson,
General Manager and Engineer.

Sunderland Corporation Tramways,
November 5th, 1906.

I notice in the Review of November 2nd that a correspondent writing on this subject attributes the phenomenon to an eating action on the rail tread caused by flashing and arcing. This gentleman is evidently not aware that rail corrugation has asserted itself on the lines of the London County Council, which, being built on the conduit principle, have no rail return.

I have studied this question very deeply, and I have come to the conclusion that the form of the cross-section of the rail, as now used, is to blame.

I believe that if the cross-section were such that the centre of the tread came vertically above the centre line of the web and lower flange, and the groove therefore more to one side, no corrugation troubles would arise. My theory is that there is a sideways bending moment on the web, owing to the tread being out of centre, and that this causes vibration, which in turn results in corrugation. In time this develops into a serious trouble, as all tramway men know.

This theory is borne out by the fact that corrugation does not occur on railways, although there the speeds and loads are so much greater.

As this remedy would entail no expense beyond cutting the rolls, it would be worth while trying a few lengths of rail rolled to this suggested section, at places where corrugation has been very bad.

It would be interesting to know the opinions of some of our tramway experts.

P. Well.

London, S.W., *November 6th*, 1906.

Patents and Prejudice.

The point of my letter was that extra imports are paid for by extra exports, so that the working man does not suffer; and this was all in connection with foreign patents not worked here. Your anonymous correspondent assumes that the imported telephones are paid for in pig-iron, and assumes that a small proportion of the price goes to labour; and this brings in the much broader question whether it is good for a country to export raw and take in finished material. This is an interesting subject, but it is too wide of Sir Joseph Lawrence's article for me to go into in your pages, even if you would let me. I notice one of the daily papers said some politician or other had drawn a red-herring across the scent, and advised him to bury it. Your anonymous correspondent is trailing a herring of portentous size, and it may be buried as far as I am concerned.

J. Swinburne.

London, S.W., *November 5th*, 1906.

In your issue of November 2nd, Mr. Richardson makes the statement that ". . . . the value of our imports above that of our exports is a measure of our general prosperity," an error into which far too many fall.

As I look at the matter, an excess in *value* of imports over exports has absolutely nothing to do with the prosperity of a nation, as I will endeavour to show. It depends entirely on their nature.

What do we profit if the whole of our imports are manufactured goods (and if not, it is only a question of degree) and our exports raw material?

According to Mr. Richardson, if our exports were valued at 100, and our imports at, say, 180, our wealth would be increased by the difference.

If the exports are raw, and the imports manufactured, and the labour on the manufactured 80 per cent. of the whole, or 144, we should be poorer by 100 — 36 = 64, that is to say, we should export raw material to the value of 100, and import it to the value of 36, the labour ceasing to be of value when the article is superseded or worn out.

Suppose we look at the reverse side of the picture and *export* manufactured goods to the value of 180 and import raw 100. We should be the richer by 64, besides paying 144 in wages in our own country, and this, notwithstanding our imports are 80 *less* than our exports.

Manufacturer.

Birmingham, *November 5th*, 1906.

May I intervene in this discussion, so far as it affects imports and exports, to suggest an amplification of Mr. Swinburne's remark that any import is paid for by sending out an export of equal value? If this primary truth had been appreciated, many of the eccentricities of the late fiscal controversy would have been lacking. But true as this remark is, it, perhaps, needs a little extension.

In addition to exports representing the commodities sent out in exchange for imports, exports may also represent (*a*) investments of capital in other countries for industrial or national purposes, or (*b*) repayments of interest on capital invested by outside capitalists in the exporting country. Conversely, imports in addition to representing commodities received in exchange for exports may represent (*a*) investments of capital from outside sources within the receiving country, or (*b*) interest on, or repayment of, capital previously lent to outside countries by the country receiving the imports.

I hope that Mr. Swinburne will accept this amplification of his remark on the economic aspect of external trade.

Statistics.

Winding Lathe.—A correspondent inquires for the makers of lathes for winding small armature and field coils.

[Several letters, which arrived too late for insertion, are held over till next week.—Eds. E.R.]

An Electric Furnace for Heating Crucibles.—The *Electro-chemical and Metallurgical Industry*, Vol. IV, No. 7, gives particulars of a furnace constructed by O. P. Watts, Ph.D., for the melting of moderately refractory metals, such as iron, without the introduction of impurities. It consists of a rectangular brick box measuring 54 × 28 × 26 in. Into this the crucibles are packed with crushed carbon, and the current is turned on until the desired temperature is reached. The cellular base consists of two courses of firebrick set on edge, and the whole holds 27 crucibles, each 3 in. in diameter and 7 in. deep. The furnace has a lining of magnesite brick to afford protection from the hot carbon, no cement being used throughout. To make the structure permanent, iron straps may be added. The furnace is of the resister type as in the Acheson graphite furnace, in which the articles to be heated are embedded in a granular resister. The crucibles are of graphite lined with magnesia, and covered with a disk of this latter material, and finally a layer of graphite to give protection from the hot carbon. The terminals consist of bars of graphite, 14 × 1 × 3 in., placed down the ends of the furnace and mortised to a horizontal bar set on edge inside the furnace. The resister consists of a mixture of coke, carbon electrodes and graphite, crushed together, and all except the coarse material used. This furnace is worked by a dynamo giving 65-125 volts, and takes a current of 150-550 amperes. It requires a variable voltage and is not intermittent but may probably be made so.

THE L.C.C. BULK SUPPLY SCHEME.

On Tuesday the L.C.C. decided by 80 votes to 34 to apply to Parliament in regard to electric supply powers, as a result of recommendations made by the Highways Committee. The Committee's recommendations appeared somewhat fully in our last issue (page 703). Briefly stated, they include the seeking of authority to enable the Council—

1. To supply electrical energy in London and certain surrounding districts.
2. To confer upon the Council power to carry out any works, including the erection of buildings, laying mains, &c., necessary to give effect to such powers.
3. To empower the Council to acquire compulsorily at the expiration of five years from the passing of the Bill, or at any time thereafter, by giving one year's notice, the undertakings of local authorities in London on the basis of the outstanding debt incurred by such authorities.
4. To enable the Council to acquire compulsorily the undertakings of companies within the proposed area of supply at the time when and on the terms on which such undertakings would become purchasable by local authorities.
5. To authorise the Council to acquire by agreement at any time the whole or any portion of any undertaking of the local authority or company within the proposed area of supply.
6. To empower the Council by provisional order or otherwise to become the authorised distributor of electricity in districts within the area of supply where such orders have not been granted or exercised.
7. To enable the Council to enter into agreements with local authorities or companies for any purposes referring to the supply of electricity.

As an amendment to this series of recommendations, Mr. R. A. Robinson moved that the Council declined to embark upon so speculative an undertaking as the compulsory supply of electricity to London and the surrounding districts, involving unknown capital expenditure at the risk of the ratepayers, and resolved to direct every effort to ensuring that the supply obtainable through existing or combined undertakings should be subject to such control as would provide a cheap supply and otherwise safeguard the interests of the public. Mr. Anstruther seconded the amendment, which, after a lengthy discussion, was rejected by 79 votes to 34. On a second division, the recommendations of the Committee were adopted by 80 votes to 34.

It was also decided to seek compulsory powers to acquire sites on the banks of the Thames at Barking and Erith for the erection of generating stations.

BUSINESS NOTES.

Milan Exhibition Awards.—Messrs. Babcock and Wilcox, Ltd., have been awarded the Grand Prize at the above Exhibition for their exhibits, which comprise: Marine-type boiler, having 309 sq. metres heating surface, fitte : with patent steam superheater and patent mechanical chain-grate stoker (not under steam); silent gravity bucket conveyor (working model); model of land-type boiler, fitted with patent steam superheater; and a collection of wrought-steel steam piping and boiler parts.

Messrs. Berry, Skinner & Co. have been awarded a gold and bronze medal for their exhibit of patent fool-proof switchgear.

Prices Advance.—Messrs. Johnson & Phillips, Ltd., and Messrs. W. T. Glover & Co., Ltd., both announce that, owing to the continued increase in the price of copper and other raw materials, they have had to raise their prices of rubber-insulated wires and cables; the addition of 10 per cent. to the list prices in their 1906 catalogues at present in force will be increased to 25 per cent. from November 1st.

"The Electric Man."—This is the name of a farcical comedy, by Mr. C. Hannan, which is to be produced to-morrow evening for the first time, at the New Royalty Theatre. There are three acts, entitled respectively "The Beginning of It," "The Muddle of It," and "The End of It," and Mr. Harry Nicholls plays the leading rôle. What it is all about we don't know.

Tyneside Industries.—From the Tyne Improvement Commission we have received an interesting pamphlet relating to the Tyneside and its advantages as an industrial centre. There is a large chart of the River Tyne from the sea to Wylam, and some fine reproductions from photographs of local views. These, together with the general information which accompanies them, should be useful to those who want to know something of the extent and varied character of the industries of Tyneside.

Trade Announcements.—Messrs. Cammell, Laird and Co., Ltd., of Sheffield, notify that on November 12th they will open a branch office in their own name at 28a and 29, Collingwood Buildings, Newcastle-on-Tyne. This arrangement has been made to meet increased business. Mr. J. Johnson, who has represented the company as district agent for many years, will control the branch.

Messrs. Armitage & Rigby, Ltd., cotton spinner and manufacturers of Warrington and Manchester, have appointed Messrs. J. W. Dering & Co., of 22, Billiter Street, London, E.C., as agents for their cotton yarns and cloths used in the manufacture of electric cables.

The Adams Manufacturing Co., Ltd., notify that from Monday last all communications regarding accounts should be addressed to them at Elstow Road, Bedford.

Messrs. Veritys inform us that from the 1st inst., their address at Liverpool will be 1, Hackin's Hey. They have found it desirable to appoint their own representative to the charge of this important district, and accordingly Mr. Harry S. Tadman (who has represented the firm for several years in the Leeds district) is taking charge of the new Liverpool warehouse. Mr. Welding, of 64, Stanley Street, who has previously been their agent in Liverpool, no longer represents them. The new premises are central and convenient, and are being well stocked with wire, cable, and electrical supplies, while a good selection of Messrs. Veritys' new art fittings will be in evidence. The telephone number is 6,248 Central.

Hand-firing v. Mechanical Stoking.—The following interesting particulars of the result of a boiler test made at the works of the Slough and Datchet Electric Supply Co., Ltd., have been placed at our disposal. The test was made between hand-firing and the Bennis sprinkling stoker and compressed air furnace. The duration of the test was eight hours, and the test was completed on October 3rd last :—

System of firing.	Hand.	Bennis stoker and compressed air furnace.
Type of boiler	Dry back marine	Dry back marine
Size of boiler	10′ 6″ × 14′ 6″	10′ 6″ × 14′ 6″
Class of coal	Best hard steam	Nutty slack
Calorific value of coal per lb. as fired	12,832 B.TH.U.	12,350 B.TH.U.
Coal burnt per boiler per hour...	588 lb.	909 lb.
Coal burnt per sq. ft. of grate surface per hour	12 lb.	18·5 lb.
Equivalent evaporation per boiler per hour	5,063 lb.	8,815·5 lb.
Equivalent evaporation per sq. ft. heating surface per hour...	2·68 lb.	4·67 lb.
Equivalent evaporation per lb. of coal	8·61 lb.	9·68 lb.
Thermal efficiency obtained ...	64·79%	75·77%
Cost of fuel to evaporate 1,000 gallons of water, as from and at 212° F.	112·0d.	69·125d.
Electricity generated	599 units	1,269 units
Fuel cost per unit	·757d.	·384d.
Extra water evaporated, as from and at 212° F. per boiler per hour	—	74·1%
Extra water evaporated, as from and at 212° F. per lb. of coal	—	12·43%
Reduction in fuel cost per 1,000 gallons evaporated	—	38·3%
Reduction in fuel cost per unit of electricity generated ...	—	49·3%

Book Notices.—*Moteurs à Collecteur à Courants Alternatifs.* By Dr. F. Niethammer. Paris: "L'Eclairage Electrique," 1906. Price 5 fr.—Readers possessing a general knowledge of alternating-current working will find this short account of single-phase commutating motors a useful and fairly comprehensive guide to the subject. The treatment is non-mathematical, and is chiefly confined to the simple series motor and the compensated repulsion motor (or series motor with transverse brushes, as the writer prefers to call it) of the Winter-Eichberg type. True repulsion motors and their many modifications are only touched on, as they have not, at present, attained practical importance. Chapter I is historical, and gives a general outline of the arrangement of single-phase motors. Chapter II deals in detail with the general vector diagram of such motors, and with the quantities which determine their torque, commutation, power factor, speed and behaviour as brakes, and concludes with a critical comparison of the various anti-sparking devices employed. Amongst these last the author still mentions the fallacious arrangement consisting of a horse-shoe electro-magnet placed in the neutral zone and intended to compensate for the transformer action in the coils short-circuited under the brush. Complete compensation in this way results in the reduction of the useful torque of the motor to zero. Chapter III deals with the practical construction and regulation of the machines, and includes particulars of various well-known makes, together with photo-reproductions of the parts of the finished machines and controller diagrams. In the last two or three pages a method of carrying out the design of such a machine from first principles is shortly indicated.

Construction des Induits à Courant Continu. Partie Mecanique. By E. J. Brunswick and M. Aliamet. Paris: Gauthier-Villars. Price 2 fr. 50.—The present writers deal with the question of direct-current armature construction in three separate volumes, covering respectively the theory and rules of winding, the practical carrying out of the winding and the mechanical design of the armature. It is questionable whether the sub-division of the subject has not been carried too far in this case, since a more combined

treatment would prevent a good deal of repetition, and give a much more complete view of armature construction. The principles underlying the mechanical design are fairly fully discussed in the present volume, but the illustrations of actual constructions might be much more numerous with advantage, and the actual expressions for calculating the various stresses should be more generally stated. Where the expressions are given, they are generally in a handy form, and special care has been taken to avoid doubt as to the units employed. After dealing generally with the constitution of the various metals used in armature construction in Chapter I, complete numerical information as to their strengths under various stresses is given in useful tabular form in Chapter II. Chapter III deals with the preparation of the disks, Chapters IV and V with the mounting of the core on the spindle or spider, and Chapter VI with the construction of commutators. Worked examples are noticeable by their absence.

The Marine Steam Turbine. By J. W. Sothern, M.I.E.S. Second Edition. London: Whittaker & Co. 1906. 6s. net.—Only in August last we noticed the first edition of this book; we highly recommended the work as being of much practical value to a station shift engineer and mechanic. The rapidity with which the first edition has run out is sufficient evidence to show that the book has been well received. The second edition contains about twice as many pages as the first, and it will be noted that the price has been raised. More complete details relating to the practical running and construction of turbines are given than in the previous edition, and a number of original sketches and photographs further illustrate the text. Though the price of the book is increased, the valuable and lucid information it contains is worth much more than is asked for a copy.

Proceedings of the American Society of Mechanical Engineers. Vol. 28, No. 1. Baltimore: The Society.—This part contains several features of interest; first, a photograph of the Engineering Building, an institution such as that which we have advocated for London for some years, for the accommodation of the various engineering societies; secondly, four papers to be presented at the New York meeting in December next—observe what ample time is allowed for their consideration in advance—of which the most interesting to electrical engineers is the report of the Committee on Standard Proportions for Machine Screws; and a few pages of "Suggestions for Authors," to guide them in the preparation of papers, drawings, photographs, &c., for reproduction in the *Proceedings*. The last-named feature might well be commended to the notice of the editors of Minutes and Proceedings of British Societies as an excellent example to follow. The suggestions given are admirable, and would be of the greatest value to the authors of papers, especially those who are novices—and to their readers. We are strongly tempted to reprint them all, but will content ourselves with quoting the following:—"Finally, there should come a very condensed summing up, in such a form that a brief glance would enable a casual reader to grasp the substance of the paper, and decide without reading the whole, whether or not he wants to examine it in detail." This paragraph rightly receives the emphasis of italics in the original. In these days of multitudinous papers on every subject under the sun, it is most important to facilitate the task of the reader, who cannot spare time to wade through the bulk of a paper unless he is thus assured that it will repay him.

The Grouping of Electric Cells. By W. F. Dunton. London: E. & F. N. Spon, Ltd. 1906. Price 1s. 6d. net.—This little book has been written to set us right on the subject indicated by the title. The author evidently feels somewhat strongly on the matter, and has expended a great deal of labour on the demonstration of the inaccuracy of the ordinary formula, and the construction of a correct rule. By assuming a case which we can only describe as absurd, employing as it does 1,201 cells, of which *all* must be used, each having an E.M.F. of 1 volt and a resistance of 1 ohm, to give the maximum possible current through an external resistance of 600 ohms, the author finds that the usual rule says put them all in parallel, while he himself would put them all in series and get a current 400 times as great. To this we would reply that any practical man would begin by throwing one of the cells away, and putting the remaining 1,200 in two parallels, giving practically the same current as the author's method, and at half the cost. But we go further—and here is the essence of our criticism—and say that the grouping of cells is a mere academic exercise, of no practical importance whatsoever. The author, we regret to say, has wasted his time, except in so far as he has benefited by the intellectual exercise in which he has engaged. At the best, his general rule, which may be, as he says, infallible, occupies a page and a quarter! Perhaps the most practical feature of the work is the section which shows how to find the smallest group of cells to accomplish a given object. But here again the rule involves the use of three formulæ, and occupies a page of matter, ending with a suggestion, in the event of failure at the first trial, to "try one cell more, and so on until the necessary number is found"! The practical man, confronted with this problem, simply calculates the watts to be given to the external circuit ($w = c^2R$), and the maximum watts that each cell can give out $\left(w = \frac{E^2}{4r}\right)$, and dividing w by w, has a close approximation to the result at once. Such a problem might arise, perhaps, once in a lifetime.

Time Tables. By T. Reader. London: Longmans, Green & Co. 1906. Price 2s. 6d. net. Fifth edition.—This is a set of tables showing at once the number of days from every day in the year to any other day, for any period not exceeding 365 days, and is intended for use in calculating interest, discount, wages, &c. The tables are arranged on a simple plan, each page giving the period to one particular day from every other day in the year, and the book is produced in a handy desk form.

The Indian and Eastern Engineer Year Book, 1907. Fifteenth issue. London: The Indian and Eastern Engineer Co., Ltd.—This useful publication consists of a diary, with a week in an opening, interleaved with blotting paper, together with a collection of useful information covering a very wide range. Calendars under various Eastern systems are given, weights and measures, Customs tariffs, postal and telegraph information, engineering tables and data, conversion tables of coinage, &c., and a vast number of other matters, the volume constituting a valuable work of reference. In particular, we note that electrical installation rules for work carried out in India have been inserted, compiled from the regulations issued by the Government of Bengal, the Calcutta Electric Supply Association, and the Bombay Fire Assurance Association. These occupy nearly ten large pages. A table of conductors, carrying capacity, &c., is given, which consists mainly of the I.E.E. tables; many of the rules are from the same source, and while it is quite proper to use them, due acknowledgment of the fact should be made.

"The Teaching of Elementary Mechanics." Discussion at the B.A. meeting at Johannesburg in South Africa in 1905. Edited by John Perry. London: Macmillan & Co., Ltd. 1906. 2s. net.

"Proceedings of the American Society of Civil Engineers." Vol. XXXII, No. 8, October, 1906. New York: The Society, 220, West 57th Street.

"Elementary Treatise on the Induction Motor." By F. J. A. Matthews. London: Biggs & Sons.

"Engineering Press Monthly Index Review." Vol. IX, No. 2, November, 1906. Brussels: Association de la Presse Technique. Fr. 50.

"Treatise on the Law and Practice relating to Letters Patent for Inventions." By Robert Frost. Two vols. Third edition. London: Stevens & Haynes. 1906.

Australia.—The Australian Customs authorities have recently given a decision to the effect that "fuses, Stellite switches, are to be classified as 'electrical materials,'" and admitted free of import duty.

New Zealand International Exhibition. — This Exhibition, which was opened on the 1st inst. in brilliant weather, is being carried out on a quite considerable scale. The floor space covers half-a-million square feet, and the exhibits displayed are valued at three-quarters of a million. Two-thirds of this value represents industrial exhibits; the remaining third, works of art. The Exhibition, which is the largest held south of the line, was thronged by crowds on the opening day, and its financial future is locally regarded as already assured. We are informed that the Exhibition, which will remain open until the middle of April next, is well worthy of a visit by tourists and others, particularly when it is remembered that, in addition, they will have the opportunity of also visiting the very attractive scenic and health resorts of the very prosperous Colony of New Zealand. The High Commissioner in London will readily give further information as regards the Exhibition and the scenic attractions of the Colony as well as regards the routes by which visitors from this country can take their passages.

Catalogues and Lists.—GENERAL ELECTRIC CO., LTD., London, E.C.—The company's "progress sheet" for October contains a description of the "Geekoduct" earthing clips; also particulars of switch and ceiling rose adapter rings and outlet plates for the "Geekoduct" conduit system, the Admiralty pattern switch, the Stanley combined water-tight switch, and pewter pendant fittings. Prices of all these lines are stated, and reduced prices for removable waterproof connections for outside shop lighting are notified.

MESSRS. COX-WALKERS, LTD., Darlington.—A number of picture postcards. One shows their motor-car driver's lamp, which serves either for inspection, dash-board illumination, or emergency purposes; another depicts a switchboard supplied by the firm for Kilmarnock; a third draws attention to their circuit-breakers; while a fourth gives an exterior view of a fine country mansion where they have put down an electric lighting installation.

THE ROYAL STANDARD ELECTRIC LAMP MANUFACTURING CO., 4, Hart Street, New Oxford Street, London, W.C.—New illustrated catalogue of miniature lamps of every description, embodying lamps for all sorts of portable and stationary lighting apparatus used with dry or storage batteries; or for running in series on the lighting main; such as bulbs for pocket lamps and lanterns, torches, &c., battery and cell-testing lamps, telephone lamps, micro, surgical and dental lamps, lamps for various special purposes, for motor-cars and vehicles of every other kind, for roof lighting, signalling, theatrical and decorative purposes; fancy lamps and lamps for photographic, military, and naval purposes, &c. A novelty in the list is a line of fruit lamps, a number of which are well shown in a separate coloured plate. The lamps are all hand-painted and represent all sorts of fruit; they are claimed to be of very artistic finish and to produce a beautiful decorative effect, things which we can quite well believe. Copies of this catalogue can be obtained on application.

PULSOMETER ENGINEERING CO., LTD., Nine Elms Iron Works, Reading.—Illustrated folding leaflet giving a good deal of information concerning several types of Pulsometer pumps.

BRITISH WESTINGHOUSE ELECTRIC AND MANUFACTURING CO., LTD.—Sixteen-page pocket-size pamphlet containing illustrated particu-

lars of their single and three-phase transformers; also a circular reprinting an article from a tramway contemporary in which a laudatory report of the Railway Commissioners of New South Wales concerning the magnetic brake in Sydney, is quoted from.

Messrs. Mather & Platt, Ltd., Manchester.—Third edition of their illustrated catalogue (24 pages, standard size, green cover) of steam engines. A brief specification of their double-acting open vertical marine type engines, and particulars of outputs, dimensions and weights of same, are followed by similar information concerning their combined enclosed high-speed engines for driving dynamos, pumps, &c.; also auxiliary machinery, including ejector, jet and surface condensers. A page is devoted to a list of steam plants supplied by the firm for different classes of works.

A.E.G. English Manufacturing Co., Ltd., London, W.C.—Folding card relating to Nernst lamps for outdoor use, showing and giving prices of the "Perfecta" fitting for "B" and "D" type lamps, and the "Westminster" and "Aldwych" fittings for "A" type.

Messrs. E. Goossens, Pope & Co., Liverpool.—Various lists relating to their electric lamps, standard patterns, plain flame and tube, twisted flame and other lamps, including heating lamps for electric radiators. One of the sheets gives a table of prices of all these. Copies of the lists will be sent to the trade on application.

Mr. G. Braulik, London, E.C.—New 10-page illustrated price list of patent arc lamp couplings. Attention may be directed to the patent rope release block cup or globe shown in this list. Various line couplings and accessories for same, arc lamp winches, mast-heads and arc lamp brackets, and the "Braulik Eclipse" flame lamp are all listed.

Messrs. J. B. Hamilton & Co. South Tottenham, N.—Circulars of "Unica" noiseless pinions, also of their vulcanised fibre.

Messrs. W. N. Brunton & Son, of Wire Rope Works, Musselburgh, have in circulation a small list relating to "hoisting wire ropes" wherein are given in concise form three constructions and three qualities in each construction, giving the ultimate stress of the rope and the price per 100 ft.; also a ready method of calculating which construction is best adapted for various sized pulleys. On the same list there are photographs and information regarding the firm's patent "Kilindo" non-rotating wire ropes. They are now sending out to any user interested in this special wire rope—which is being largely used for cranes, &c.—a question sheet which, when filled in, enables the firm to quote for a construction of "Kilindo" wire rope to take the place of the rope of ordinary construction he is at present using.

Messrs. Falk, Stadelmann & Co., Ltd., of Farringdon Road, E.C.—Illustrated circulars relating respectively to motors and induction coils for the Christmas trade, and the "Aureola" intense flame arc lamp, both lists showing prices; a third sheet announces some specially low prices of D.P. fuseboards.

Wilson-Wolf Engineering Co., Ltd., Laycock's Mill, Thornton Road, Bradford.—New catalogue consisting of a number of well arranged leaflets brought together in a brown binding cover with provision for the addition of later lists as issued. These publications give information, prices, and neat little illustrations of single and polyphase, induction motors, direct-current dynamos and motors of smaller sizes, ventilating fans, &c.

Messrs. G. Straus & Co., Ltd., London, E.C.—Abridged list (4 pp.) showing and pricing a number of electrical novelties that they are introducing for the Christmas trade—including small motors, electro-medical apparatus, induction coils, and electric bell sets.

Installation Contract.—The contract for the electrical installation (including lighting, heating, bells and telephones) at the large new residence now being built for Mr. W. H. Heywood, Huddersfield, has been secured by Mr. Chas. Pullan, of Bradford.

Price Advance of Telephone Apparatus.—At the beginning of the present year the principal makers of telephone and telegraph apparatus in Germany increased prices by 10 per cent. all round, in consequence of the rise in the cost of raw materials. Since then the latter have become dearer, and circulars have just been issued by 22 of the leading firms, announcing a fresh advance of 10 per cent. in manufactures, thus making a total augmentation of 20 per cent. since the commencement of the year. It is pointed out that copper rose by 24 per cent. between January 1st, 1905, and January 1st, 1906, and by 46·4 per cent. by October 20th, 1906; tin advanced by 23 per cent. and 47 per cent., and lead by 13·4 per cent. and 52 per cent. respectively. The circulars add that not only is there no hope of a decline of the prices of raw materials within a conceivable period from the present time, but that a still further rise must be expected.

"Anti-Sulphuric" Enamel.—Messrs. Griffiths Bros. & Co., of Macks Road, Bermondsey, have issued circulars to the trade, notifying that they are the only manufacturers of "Anti-Sulphuric" enamel, and that the rights of this trade-name are theirs. No employé who has ever been engaged in the manufacture of this enamel, which has a reputation of nearly 20 years' standing, has ever left their employ or been discharged by them.

Brush Contracts.—The Brush Electrical Engineering Co., Ltd., has received a contract for 40 bogies for passenger coaches for the Soudan railways, and for four composite passenger coaches for the Highland Railway.

"On-Off" Holder.—In our issue of October 19th we gave illustrations of the patent keyless switch-holder, which is made by the British Electric Co., Ltd., of 116, High Holborn, W.C. This device has been submitted for test to the Electrical Standardising, Testing and Training Institution, which reports that it is thoroughly well made, and performs its switching action in a very simple and efficient manner. The holder is very inexpensive, and can be used in place of any ordinary holder, one of its advantages being that when a number of lamps are controlled by one switch, any that are not wanted can be put out of use by simply turning them in the holders. These holders can also be used as batten-holders, in which respect, we believe, they are unique amongst switch-holders; and they are of British manufacture.

Condensing Plants.—The Mirrlees Watson Co., Ltd., of Glasgow, have received the following important orders for condensing plant:—

David Colville & Sons, Ltd.—One barometric jet condensing plant, duty 180,000 lb.
Summers & Co., Ltd. (per Mr. P. J. Mitchell),—One surface condensing plant, duty 44,000 lb.
Blackpool Corporation.—One surface condensing plant, duty 16,000 lb.

Dissolutions and Liquidations.—Smoke Abolition Syndicate, Ltd.—This syndicate is winding up voluntarily.

Foreign Electrical Bleaching Patents, Ltd.—This company is winding up voluntarily.

"Otto" Electrical Manufacturing Co. (1905), Ltd.—A meeting of this company is to be held at 14, George Street, Mansion House, E.C., on December 5th, to hear an account of the winding up from the liquidator, Mr. E. H. Fletcher.

Mersey Electric Supply Co., Ltd.—A meeting is to be held at 41, North John Street, Liverpool, on December 11th, to hear an account of the winding up from Mr. John G. Hodgson, liquidator.

Shanghai Electric Tramways, Ltd.—A meeting is to be held at 19, St. Swithin's Lane, E.C., on December 5th, to hear an account of the winding up from the liquidator, Mr. G. G. Walker.

Crystal Palace District Electric Supply Co., Ltd.—A meeting is to be held at Dashwood House, E.C., on December 6th, to hear an account of the winding up from Mr. James Gray, liquidator.

Bankruptcy Proceedings.—T. F. L. Rene.—At a sitting of the London Bankruptcy Court held on November 2nd, before Mr. Registrar Brougham, T. F. L. Rene, electrical engineer, late of 6, Snow Hill, and 9, Plum Tree Court, Farringdon Street, E.C., applied for an order of discharge from bankruptcy proceedings instituted by creditors last May. Mr. Egerton S. Grey, Official Receiver, reported that the provable debts amounted to £413; no assets were disclosed, and nothing had been recovered. The trustee (Mr. Walter Osmond) had stated that he had knowledge of assets of considerable nominal value, claimed by third parties, which he was unable to estimate, and which he could not realise owing to the absence of funds to take legal proceedings. As offences the Official Receiver reported (1) insufficiency of assets to pay 10s. in the £ to the creditors; (2) imperfect book-keeping; and (3) misconduct in transferring his available property to his wife with intent to defeat and delay his creditors. The learned Registrar upheld the report, and imposed a further suspension of three years. Order entered accodingly.

T. C. Hodgkinson (the Electro-Neurotone), Shepherd's Brush.—Second and final dividend of 3d. in the £, payable from November 8th, at Tower Chambers, London Wall, E.C.

G. A. Benton, electrical engineer, Shareshill, Stafford.—First and final dividend of 2s. 8d. in the £, payable November 6th at the Official Receiver's office, Wolverhampton.

J. E. Austin.—The first meeting of creditors was held on Monday at the London Bankruptcy Court under the failure of J. E. Austin, formerly electrical engineer, of 40, Upper Baker Street, and 27, George Street, Portman Square, W., and now carrying on business at the Sports Depôt, Felixstowe. Mr. W. G. Williams, Assistant Receiver, reported that the debtor started in Upper Baker Street 10 years ago, and traded there until the early part of last year, when he moved to George Street. The business was managed latterly by his son, the debtor having, for many years past, been in such a bad state of health that the doctors forbade his remaining in London. Twelve months ago he opened the stores at Felixstowe, having, at the time, an annual income of £100 from freehold property. A statement of affairs had been lodged showing gross liabilities £508 17s. 11d. (unsecured £459 1s. 3d.) and assets £51 only, the stock and office furniture at George Street having been taken under a judgment for rent. The debtor, who filed his own petition on October 17th, attributed his failure to losses and expenses incidental to his ill-health, extending over five years. Mr. G. B. Brooks (Gery & Brooks) attended the meeting on his behalf, and no offer being made, the case was left with the Official Receiver to be wound up in bankruptcy, the debtor's public examination being appointed for November 28th. Appended is a list of the principal creditors:—

Unsecured.

Michieli, A. and E., Paddington	£110
Austin, Mr. A., Goldhawk Road, Shepherd's Bush	56
General Electric Co.	39
Woodlands, Miss A., Felixstowe	32
Brackenbury, Mrs. E., Weymouth Street, W.	23
Edison & Swan Co.	18
Veritys	14
Angus & Co.	14
Ray & Flower Ellis, Margaret Street, W.	11
Turner, G. E., High Street, Marylebone	11
Wisbey & Co., Houndsditch	10
Simpson, —, St. Albans	10

Partly Secured.

Provincial Union Bank, Ipswich (Security valued at £30.)	£40

LIGHTING and POWER NOTES.

Bilston.—A disastrous fire occurred last Saturday at the steelworks of Sir A. Hawkins, Ltd., Spring Vale, which resulted in one of the power houses being destroyed. It was erected six years ago and contained plant utilised for generating electricity from the waste gases from the adjoining blast furnaces. It is supposed that the fire arose from the explosion of a quantity of gas. We understand that the generating plant is duplicated so that a supply of electrical energy will still be available.

Blackpool.—The plant at the Corporation electricity works is to be extended at a cost of £8,250.

Bo'ness.—At a recent meeting of the T.C. further correspondence was read between the town clerk and the Board of Trade on the subject of the application to the Secretary for Scotland for a supplementary loan of £4,000, to carry out extensions of the E.L. scheme. The town clerk wrote to ascertain whether in the event of the Council promoting a private Bill in Parliament to legalise the present working agreement with the National Electric Construction Co., the Board would oppose such a measure. The Board first replied evasively, but in another letter Mr. Pelham, the secretary, replied that the B. of T. had been advised by its law officers that the Bo'ness agreement involved a divestiture of the Council's power under its lighting order, to the company, and as this constituted an infringement against Sec. 11 of the E.L. Act of 1882, it was not prepared to consent to the agreement in its existing form. On the motion of the Provost, it was unanimously agreed, acting on the advice of the Parliamentary agents, to give notice of the intention to apply to Parliament for a Bill or provisional order, to legalise the existing working agreement with the National Electric Construction Co.

Bridlington.—In deciding to install waterworks pumping machinery, the T.C. has agreed to invite tenders for electrically-driven plant, as well as for steam and suction-gas-driven machinery.

Canada.—Ontario.—Our Toronto correspondent learns that there is reason to believe that the Ontario Power Co. has offered to supply the Hydro-Electric Power Commission with energy at a rate something under $12 per horse-power. It has been officially announced that no modification of the Power Bill may be looked for in regard to its relation with power companies.

Cardiff.—The E.L. and Tramways Department at Cardiff has recently issued a booklet, some 5,000 copies of which are being distributed in the area of supply. Apart from being a pamphlet setting out the advantages of electric lighting, heating and electric driving, it contains a fund of information for those at all interested. The style is simple and concise—an important point, but one very often neglected when a booklet of this description is written up. The electrical unit of power is explained, also the standard candle-power. Glow lamp, Nernst lamp, and arc lamp data are set forth in a manner which show at once that there is no intention to mislead the consumer, a point the Department wishes to emphasise. Bad apparatus is largely responsible for the adverse opinions we hear sometimes expressed against electricity for lighting, and the Cardiff Department has not omitted to bring prominently before its customers this important fact. A showroom is being prepared where consumers will be able to test motors, lamps, radiators, &c. The booklet is very nicely printed on art paper, and contains one or two very good illustrations relating to electric driving.

Continental Notes.—France.—The *Tribune* correspondent at Geneva says that several members of the Paris municipality and engineers have arrived there to examine a scheme for harnessing the River Rhone, in order to supply electrical energy to the French capital. It is proposed that a dam should be built across the Rhone at Seyssel, near the Swiss-French frontier, and electric generating stations constructed, at a probable cost of 60 million francs. It is proposed to erect an overhead transmission line to Paris.

Germany.—The municipal authorities of Siegen are about to extend their E.L. plant at an estimated cost of £30,000.

Eccles.—The T.C. has decided to supply energy to mills, for lighting, at 3d. per unit, less 5 per cent. on accounts exceeding £100 per annum, provided the supply is not required between 5.30 and 10 p.m.

Hemsworth.—As the electric light company has not complied with various conditions, nor paid the £250 deposit, the B. of T. has asked the U.D.C. if it has any reason to offer why the E.L. order should not be revoked. The Council has replied favouring another year's extension of the order.

Hull.—The E.L. Committee of the T.C. has decided to add two transformers to the plant at the electricity works at a cost of £2,968, for the supply to the works of the National Radiator Co.

Leyton.—The U.D.C. has fixed the price of energy for the tramways at 1¾d. per unit to March 31st next, when the rate will be adjusted to 1¼d. from the date of the opening.

Little Lever.—The U.D.C. has approved of a draft agreement with the Lancashire Electric Power Co. for the transfer of the Council's E.L. order.

London.—City.—A return, in which it was alleged that the cost of lighting the City streets by gas was cheaper than by electricity, was considered at a meeting of the Corporation on the 1st inst. Recommendations in the report that the City of London Electric Light Co. be requested to remove certain of its electric lamp standards in the streets, and that incandescent gas lamps be substituted, gave rise to discussion. Sir Richard Stapley moved that the recommendations be sent back to the Committee. He complained that the company had not had an opportunity of showing what it could do. Mr. Deputy Millar Wilkinson seconded this, saying he thought the company had not been treated with absolute fairness. The resolutions were adopted.

L.C.C.—At Tuesday's meeting it was decided to lend £10,763 to the Battersea B.C. for E.L. machinery and meters.

Mansfield.—On Saturday last Mr. H. R. Hooper, L.G.B. Inspector, conducted an inquiry into an application by the Corporation to borrow £26,710, of which £8,000 is for electricity purposes.

Newark.—The U.D.C. has decided to apply to the B. of T. for an amended order authorising the transfer of the E.L. order to a private company.

New Malden.—The U.D.C. on Tuesday sealed an agreement with the County of London Electric Supply Co., Ltd., for the supply of energy to the district. The charges are to be 7d. per unit for the first 180 hours consumption in the winter months, and 90 hours in the summer months, and 3d. per unit afterwards. The charge for power purposes is to be 2d. per unit.

Newport.—The T.C. has resolved to apply to the L.G.B. for sanction to a loan of £20,000 for E.L. purposes.

Oldbury.—The U.D.C. has sealed the transfer of the E.L. order to the Staffordshire, Worcestershire and Shropshire Electric Power Co. upon payment of £500, which covers the cost of obtaining the order.

Penge.—The South Metropolitan E.L. and P. Co. has informed the U.D.C. that it has decided to reduce its price for energy for street lighting in Penge.

South Africa.—Johannesburg.—On Saturday night, 6th ult., at Long's Hotel, a banquet was given in honour of the contractors for the erection and equipment of the electric light and tramway generating station (Messrs. D. Stewart & Co.) Mr. Lee Murray (Messrs. Siemens, Ltd.) presided, and was supported by the Mayor and many gentlemen connected with the electrical engineering businesses of the Rand. The Mayor replied to criticisms as to the working of the electrical systems, and was very optimistic as to the future of the undertaking. Mr. W. H. Dawbarn said that he had no misgivings as to how the working would turn out. He was quite sure that before many months had passed the troubles with which they were confronted would have disappeared. These troubles were due to the great distance they were from the manufacturing works. He had no doubt of the ultimate success of the scheme.

Boksburg (Transvaal).—The E.L. plant purchased from Messrs. E. H. Gellender & Co. by the T.C. last month is of 100 kw., in two sets of 50 kw. each; there is also a pole line 5 miles long. The municipality intends in the near future to obtain power in bulk from the E.L. works at Brakpan, which will enable it to maintain the service during the full 24 hours, and by means of which it hopes to be able to reduce the price to 6d. per unit, meanwhile the rate will be reduced from 1s. to 9d. per unit.

Stockton-on-Tees.—In regard to the application of the Cleveland and Durham County Electric Power Co. for permission to supply energy for power purposes within the borough, the T.C. has decided not to give general consent, but to consider each application on its merits.

Willesden.—In 1904 an application was made by the U.D.C. to the L.G.B. for sanction to a loan of £3,000 for "hire-purchase wiring." The Board refused the application upon the ground that the Council was precluded from fixing electric wiring on consumers' premises, except in the cases where the Council is supplying fittings on hire. Instructions are now to be given to the electrical engineer to prepare an estimate for providing and fixing through the medium of a contractor, in order to comply with the proviso, electric wiring, fuses, switches, fittings, lamps or other apparatus on the hire or hire-purchase system.

Wrexham.—The T.C. has decided to engage an expert to report upon the working of the electricity department.

TRAMWAY and RAILWAY NOTES.

Belfast.—On Saturday midnight a mass meeting of the tramway employés was held, when it was decided to strike if an ultimatum to the Corporation was not accepted. The manager, supported by the Corporation, refuses to reinstate some of the men who have been discharged, hence the threatened strike. The Corporation has instructed the Tramway Committee to deal with the men's grievances, and to report on the same.

Cheadle.—The Cheadle and Gatley U.D.C. has decided to continue its opposition to the introduction of electric tramways into the town by the Manchester Corporation.

Continental Notes.—Germany.—Herr Breitenbach, the new Prussian Minister of Railways, has been interviewed on the subject of the suggested conversion of the Berlin city railways to electric traction, especially as the financial side of the question is to be discussed with the Ministry of Finance during the ensuing winter. In the course of his observations the Minister, after expressing great interest in the subject, is reported to have stated that the fact cannot be left out of consideration that the problem is not only large and difficult, but also an expensive one. The scheme involved a cost of more than £5,000,000, which would burden the Prussian State railway budget for a number of years. It was urgently necessary to meet the increasing traffic requirements, and the question was whether that object could be achieved by the electrical transformation of the Berlin city railways in such a high degree as the public thought. In any case, the conversion could not take place all at once. It would require years, and it was still possible that the equipment of the electrically worked city railways, would then be overtaken by something new. The assumption was that the electrical transformation of the railways would only permit of the traffic being increased by 30 per cent. at the most, but that would scarcely meet the requirements of the growing traffic of greater Berlin. It would, therefore, be necessary, the Minister proceeded to remark to have recourse to new means, and in that connection a scheme existed for the erection of a second storey of tracks over the old city railways. By that means the traffic facilities would doubtless be increased by over 100 per cent. As against the advantages of rapidly starting, the use of longer trains and a more frequent service, had to be set the fact that it would not be possible to travel at a higher speed than 22 miles an hour on the electrically transformed city railways. The traffic would thereby certainly increase, but the expenses would also grow. In conclusion, Herr Breitenbach observed that the State railway authorities would be able to obtain many noteworthy explanations of those points from the working of the electric connecting railway between Hamburg and Altona, which was to be opened in next February or March.

An electric tramway is about to be constructed between Castrop and Rauxel.

Italy.—Messrs. Ganz & Co., of Buda-Pesth, have secured a contract to convert the railway between Savona and San Giuseppe, a distance of 16½ miles, to electric traction.

Switzerland.—It is announced that the general administration of the Swiss State Railways have declined to entertain the proposal put forward for the transformation, to electric traction, of the Gothard Railway, by the Oerlikon Engineering Works in conjunction with the Siemens-Schuckert Works Co. and certain financial institutions, as was recently mentioned in these columns. On the other hand, the Gothard Railway Co., which is supported by the Federal Council, has entered into an agreement with the Tessin (Ticino) Cantonal Government, which confers upon the company, apparently on behalf of the Swiss State Railways, a concession for the utilisation of the water power of the Upper Leventina. The concession is for a period of 50 years, although it will be capable of renewal, as the agreement provides that no difficulties are to be laid in the way of its prolongation at the end of the term. It is stipulated that the Gothard Railway Co. should pay a single sum of £12,000 to the Tessin Government for the concession, and also the amount of £3,800 per annum. The Gothard Railway will be expropriated by the State in 1909, and it is therefore obvious that the company is merely acting for the Federal Railways, in the acquisition of the concession. This conclusion is all the more evident seeing that the company, in view of the forthcoming transfer of its undertaking to the State, has itself declined to consider proposals for the conversion of the line to electric traction.

Crewe.—A large electrical signalling installation was put into operation from one box on the 5th inst. This new box covers the Manchester, Liverpool and Cheshire lines, and it is stated that the signals at London Road Station, Manchester, are next to be electrified.

Halifax.—All the vacancies caused by the strike have, we believe, been filled by the Corporation, but there appears to be still about 100 of the men out of employment, and the Executive Committee is considering the question of allowing them "victimised pay" in place of "strike pay."

Leyton.—The U.D.C. has received from the B. of T. sanction to borrow £27,000 for the purchase of 40 tram cars.

London. — L.C.C. — On Tuesday the Council postponed the consideration of a joint report by the Finance, Highways and Improvements Committees on the subject of street improvements, in connection with tramways. It is stated that from the returns recently issued, 31 tramway street improvements have been authorised subject, in most cases, to a proportion of the cost being charged to the tramways account. The total estimated cost of such improvements is £1,255,961, of which an aggregate sum of £358,230 will ultimately become chargeable to the tramways, and of which £153,004 had already been charged on March 31st, 1906. The allocation of the cost according to the principle of one-third to the tramways account and one-third to the improvement, the joint report observes, is obviously one which cannot be defended on purely logical grounds.

Swansea.—We understand that a special meeting of the Council was to be held on Monday, at which a resolution was to be moved to give notice in writing to the tramways company requiring them to sell to the Council the undertaking authorised by the Swansea Tramways Act, 1878.

TELEGRAPH and TELEPHONE NOTES.

Australian Telephones. — The Postmaster-General stated recently that the capital cost of the telephone system throughout the Commonwealth was £1,428,000. For the year 1905 the revenue derived from the system was £323,322. Operating and working expenses, &c., amounted to £171,497. The capital cost of the metropolitan exchange networks is set down at £1,200,000, in all the capital cities. The revenue derived from the last-named source amounted to £238,000, and the operating and working expenses amounted to £124,000.—*Australian Mining Standard.*

Grenada.—The Colonial Report for Grenada for 1905 shows the receipts for telephone service to have amounted to £1,459, as compared with £1,430 in 1904, while the ordinary expenditure for maintenance of the system was £1,054, as against £1,111 for the same years. Besides this, £226, the annual repayment to the Colonial revenue on account of the construction loan, was met, as well as £245 for reconstruction work.

Wireless Telegraphy Conference.—The following are the principal articles of the Convention signed at Berlin on Saturday last:—

Article 1.—The high contracting parties shall apply the following arrangements in all stations open to general wireless telegraphic service between the coast and vessels at sea (both in the coastal stations and those on shipboard) which are established or worked by the contracting parties on their coasts or on board vessels flying their flag. They also bind themselves, in the event of their authorising private enterprises to open or to carry on similar stations, to impose the observance of these arrangements on such enterprises.

Article 3.—Coastal stations and stations on shipboard are bound to interchange telegrams without distinction of the system of wireless telegraphy adopted by them.

Article 4.—Each of the Governments undertakes either to connect the coastal stations with the general telegraphic system by means of special wires, or to adopt other measures which will ensure expeditious communication between the coastal stations and the telegraphic system.

Article 6.—The high contracting parties reserve the right to prescribe or to admit, apart from the general service installations, the institution and exploitation of other technical plant with the object of establishing special wireless communication, without publishing the details of such plant.

Article 7.—The working of wireless telegraphic stations shall be organised, as far as possible, in such a manner as not to disturb the service of other stations.

Article 16.—An international bureau, placed under the high authority of the superior administration of one of the contracting Governments, shall be established and charged with collecting, co-ordinating and publishing information of all kinds relating to wireless telegraphy, with examining applications for modifications in the charges and in the *règlement*, with promulgating the changes adopted, and generally with understanding all studies and with executing all the work which shall be submitted to it in the interests of international wireless telegraphy. The cost of this institution shall be borne by all the contracting States.

Article 17.—The high contracting parties agree to refuse authority for the installation and exploitation, on their territories, of wireless telegraphy stations by any private undertaking which (on the territory of a non-contracting State) would work stations of this nature and refuse to conform in regard to these installations to the provisions of the present Convention. This clause shall not apply to States which declare that they are unable to put it into force by reason of their internal legislation.

Article 18.—The high contracting parties reserve to themselves the right of fixing the conditions under which they are willing to admit, for the purposes of a wireless telegraphy service, stations which do not conform to the provisions of the present Convention.

In a supplementary agreement most of the Powers adopted compulsory intercommunication between ships at sea; but Great Britain, Japan, Italy, Mexico and Persia withheld their approval.

The Convention is to come into force on July 1st, 1908; and the next Conference is to be held in London in 1911.

On Sunday last the German Emperor entertained the two senior delegates of each Power to luncheon.

(Continued on page 755.)

TWO ELECTRICAL FACTORIES AT BIRMINGHAM.

I.—The Manufacture of Electric Cooking and Heating Apparatus.

We forget how many years ago it is since we first heard Prof. Ayrton discoursing before a popular and fashionable West End audience at the Royal Institution on the various good points that could be advanced in favour of the use of electricity for cooking and heating appliances. At a guess, we should put the date at about 15 years ago, but we vividly remember how his practical demonstration of what a bachelor could do in the way of cooking his own morning ham and eggs or steak, and so on, for a farthingsworth of energy (at the then rates) caught the fancy of his hearers. Little use had been made of electricity in these directions then.

In the interim many public lecturers of less distinction have given impressive demonstrations of a similar kind before less distinguished audiences in a hundred parts of the country, and in that and a variety of other ways, including attractive local exhibitions, the education of the public has proceeded; during the same period the charges for electricity have been cheapened, while the initial cost of the necessary appliances has been reduced to figures more within the compass of the average purse. Fifteen years is a lengthy period in such a matter as electricity supply; many things that were then but as mustard seeds in dimensions have become large industrial trees for electrical engineers and others to find lodgment in their branches. Electric cooking and heating has been a plant of tardier growth. The strong arguments of cleanliness and convenience have enabled some degree of progress to be made, but when anything is more costly than what it tries to supersede, the conservatism of the British public is tenfold greater. Little more than pin-pricks have as yet been given by electricity to the gas and coal fire industries—and initial cost and cost of operation are the chief reasons therefor, though the limited area covered by supply mains may have had something to do with it. As a heating agent, electricity has made greater advance than in electric cooking, but in the latter direction at the present moment there is a very healthy progress beginning, while in the former we might almost say there is a mild sort of boom. Central station engineers, and electricity supply publicity departments all over the country, are taking both matters up in earnest just now, to see what they can make of them as a desirable day load. They have the power to exercise a good deal of influence upon the public mind in this direction, and it is very desirable that their efforts should be successful, both for their own sakes as purveyors of electricity, and for the sake of those firms in the electrical trade who manufacture or sell the needed apparatus.

We cannot, in the generality of cases, count upon the private consumer abandoning his gas or coal fires from his entire residence at one fell swoop. A bedroom kettle or perhaps a drawing room radiator, a pair of curling irons or a flat-iron, has frequently been the thin end of the electrical wedge. These serve to introduce the householder to the convenience and cleanliness of electrical apparatus, and in a measure incline him in time toward the adoption of a complete electric cooking and heating installation from kitchen to bedroom. That there will be a big demand before long we are confident, but it will be necessary in bringing that about to induce the consumer to seriously weigh the advantages—such as the saving of domestic labour, the avoidance of smoky chimneys and the other kindred nuisances consequent upon our so deeply-rooted affection for old king coal fire.

We had an opportunity last week of visiting a factory which has recently been equipped solely for the manufacture of electric heating and cooking apparatus, and being the first works of its kind to be described, we think the particulars may be of some interest to our readers. We refer to the works that have been occupied by the British Prometheus Co., Ltd., at Salop Street, Highgate Park, Birmingham, since they removed there from Kingston-on-Thames in March last.

First we may turn our attention to the power house. The plant here includes a Crossley suction producer plant. A 94-H.P. gas engine running at 200 revolutions is coupled to a 66-KW. 220-volt single-phase, 50-cycle Phœnix Dynamo Manufacturing Co.'s belt-driven alternator, with separate exciter on the same shaft. The switchboard, which consists of three marble panels, is of Dorman and Smith's manufacture, with Evershed & Vignoles' ammeters and voltmeters and B.T.-H. watt-hour meter. Room is provided for an additional 94-H.P. set, and the switchboard is made up as a balancing board, capable of distributing the load between the two sets in any required proportion, the object of this arrangement being to avoid the difficulty of paralleling gas-driven alternators working on fluctuating loads. By the side of the switchboard is the log-sheet table on which are recorded the fluctuations of the load in the four main circuits. This is kept for the purpose of checking wastage in the heating and lighting circuits and to facilitate control of load fluctuations.

The producer house adjoins the power house, and here space is provided for another producer of equal capacity, and the feed pipes are so arranged as to make it possible, without disturbing existing arrangements, to ultimately feed either engine from either producer.

The coaling platform is on a slightly lower level than the roadway, so that the anthracite can be tipped direct from the carts into the bunkers and conveyed to the coaling platform (where each pound is weighed and registered) with the least amount of work.

Water for the coke scrubbers is obtained from a water tower, on the top of which is a tank of large capacity, supplying most of the water required for the factory. A pump connected to the main shafting in the machine shop normally keeps this tank full, but there is a connection to the town water main in case of temporary need.

The main switchboard feeds a number of sub-boards throughout the buildings, which in turn supply the various asynchronous motors employed for the machine shop, polishing shop, plating shop, &c., and the various heating and lighting circuits and testing transformers.

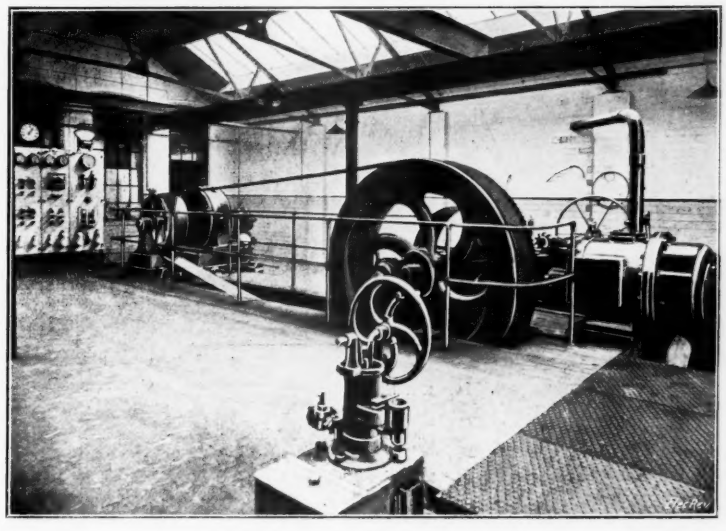
In the machine shop the machines are grouped on a line of 2½ in. shafting, passing along the entire length of the shop and driven by a motor, slung in a steel cradle midway along the shafting. A number of high-speed presses are employed, cutting out blanks for heating elements, stamping and flanging in one operation bottom plates for kettles, &c., forming element frames, duplex riveting and drawing metal cups for regulating plugs, &c. Besides the small lathes employed, there are an 8½-in. centre-back geared screw-cutting and surfacing machine and making-up press tools, also a large milling machine with 3 ft. 6 in. long and 2 ft. transverse traverse, which is used for facing hot plates, machining castings and element seatings, &c. The principal other machines are bending rolls for dealing with 12 B.W.G. mild steel plates 3 ft. wide, which ultimately are employed on hot cupboards, roasting ovens, &c., and guillotine shears for dealing with plates up to 14 B.W.G. and 3 ft. 6 in. wide in nickel-faced steel for plate-warmers, convector bodies, &c. There are a couple of high-speed emery bobs at work and a blower for compressed air for the tinsmiths' soldering irons and brazing hearth.

Adjoining the shop is the metal stores in which copper, brass, steel, iron, nickel steel and German silver sheets, rods, tubes, &c., are kept.

The assembling shop, which is about 160 ft. long, with roof and side lights, is fitted up with three rows of benches running the entire length of the shop; one on each side and one double width in the centre, with the foreman's office situated midway down the shop. On each bench, between each two men, a lamp testing device is fitted for locating premature shorts whilst assembling. At the end of the shop a number of automatic soldering irons are at work on various kettles, jugs, &c., the temperature being kept constant by means of a compressed air and gas flame playing upon the large end of the bit. Midway down the shop is situated a large hot water tank into which all liquid heaters are placed previous to their being moved to the test room for the purpose of testing for air leakages in the heating chambers of the utensils. Off the main shop there is

another, about 50 ft. long, which is exclusively devoted to the assembling of convectors and radiators.

The test room is approximately 60 ft. long, and it is lined along the walls with 12 switchboaads, built on angle-iron framework and bolted to the walls, and separated from them by a distance of 2 ft. in order to allow of a clear gangway behind the boards. The total length of the switchboards is about 80 ft., and from them any power up to about 90 H.P., at any voltage between 50 and 600, can be taken. Each board is provided with a paralleling panel, whereby it is possible to connect 50 pieces of apparatus of the same voltage in a space of about 3 or 4 minutes, and the arrangements are such that it is not a difficult matter to put on 100 pieces of apparatus with 20 different voltages in a period of about half-an-hour. Along the centre of the room are tables running on castors for dealing quickly with large quantities of small apparatus. Two Kohlrausch bridges are continuously employed for measuring the resistance of elements and of the tested apparatus, and each heater, after being measured for insulation and resistance, is entered into the test book for reference. The finished goods enter on one side of the test room when they are subjected to an insulation test of 500 or 1,000 volts alternating, and then pass down the room for a working test at 10 per cent. over normal power, after which their resistance is measured, and they pass out of the other side of the room and down to the polishing or viewing room, as the case may be.

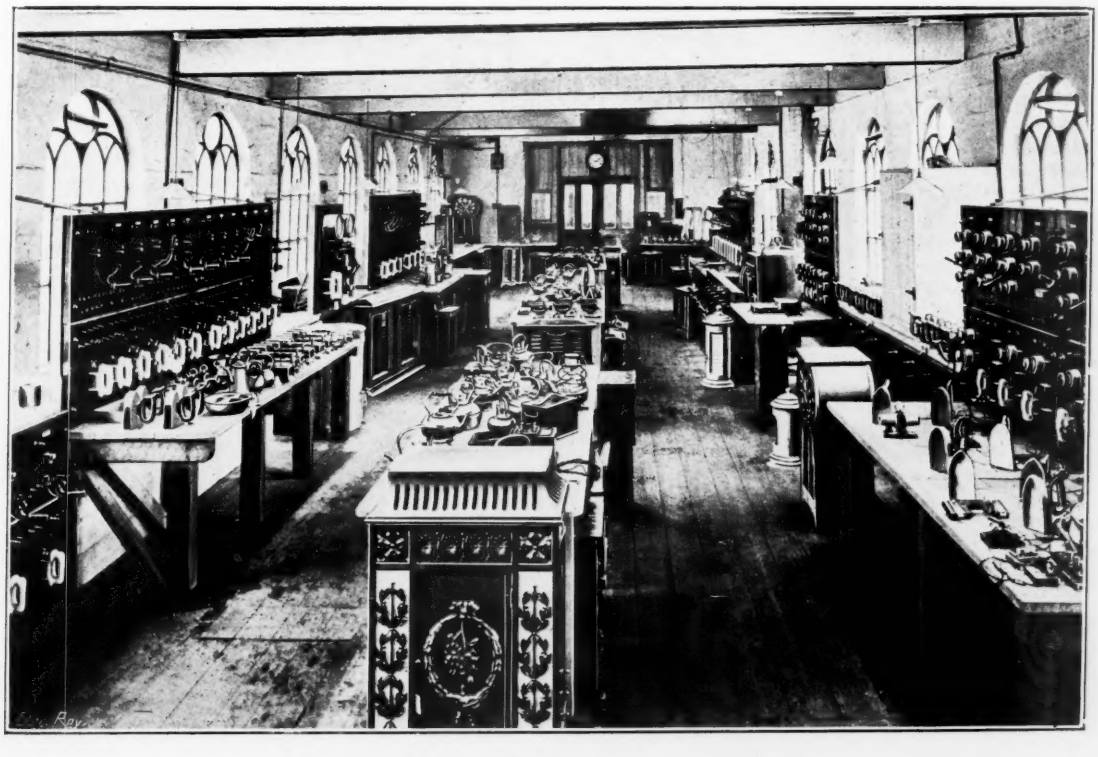


The Power Plant at the Prometheus Factory.

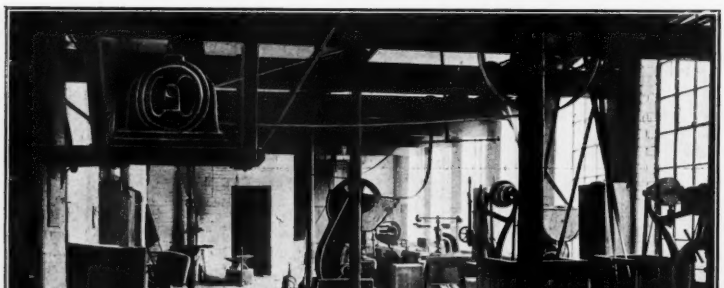
In the polishing room there are three double-ended bobs, which deal with the finished work from the test room, another being employed on sanding, whilst a high-speed flexible shaft is used for removing any traces of furring or discoloration on the interior of any vessel, caused by the test it has been through. An air extractor is fixed in the centre of the shop and from it radiate a number of ducts, each of which terminate in a funnel situated immediately under the polishing mops. The fluff, powder, sand, &c., are carried down the ducts and forced out of the shop.

The plating and bronzing shop is situated midway between the two main lines of buildings, and here the operations of pickling and copper, nickel and silver plating are performed. The enamelling, lacquering and paint-shop adjoin the polishing shop, and are separated from the main buildings on account of fire risk.

In the element room the sorting, preparing, &c., of the mica (used for the heating elements) is accomplished, and the latter are made and tested. A number of dead-beat, direct-reading ohmmeters are employed for measuring the approximate resistances. The elements are then flashed at red heat, when they are examined for small defects in the films or the mica before being cased up and dispatched to



Test Room for Electric Heating and Cooking Apparatus.



View of Part of Prometheus Machine Shop.

the element stock room, where they are tested for insulation and resistance, and afterwards classified and put up into boxes. We are informed that about 50,000 to 60,000 of these elements are usually carried in stock. From this room they are ultimately given out to the assembling shop.

The works include a research and experimental room in which continuous current from 2 to 200 volts is available from a Pritchetts & Gold battery, charged from a motor generator, and alternating current from 2·5 to 600 volts, from two transformers, whilst a small transformer giving 2,500 and 5,000 volts, is used for making tests on insulating materials, &c. Gas and water mains are run into this room for making comparative tests, &c. On one side of the room is a reflecting d'Arsonval galvanometer, fitted with a Nernst lamp, electric pyrometer, standard electrostatic voltmeters with multipliers, calorimeters and other apparatus necessary for the exact determination of heat measurement investigations.

The drawing office adjoins the engineers' and works manager's offices, and the estimating and costing department is also under the same roof.

In addition to the above shops there are brazing, welding and brass casting shops and a pattern room, but space does not permit of any description of them.

The various offices, stockrooms, &c., are in direct communication with each other by means of a complete system of multiple-way telephones.

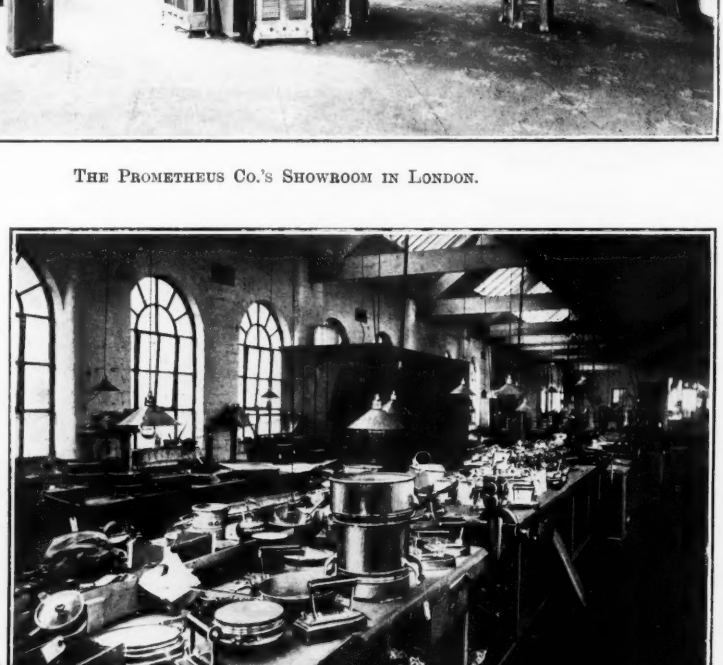
The clocks in the factory and offices, and the time recorder, are electrically driven. Four large electric bells in various parts of the works are electrically controlled, and these ring automatically at fixed periods. A kitchen for the workmen is now in course of construction, in which, we understand, all the food will ultimately be cooked or heated electrically.

We referred in our issue of September 28th, 1906, to the very fine showroom that the company recently opened in Oxford Street. In order to convey to the trade a better idea of the extent of this establishment, we give a photograph of it below.

The Prometheus Co.'s Showroom in London.

II.—The Making of Conduits for Electric Wiring.

Another Birmingham factory which should possess considerable interest for our readers, especially those who are concerned with electric wiring work in



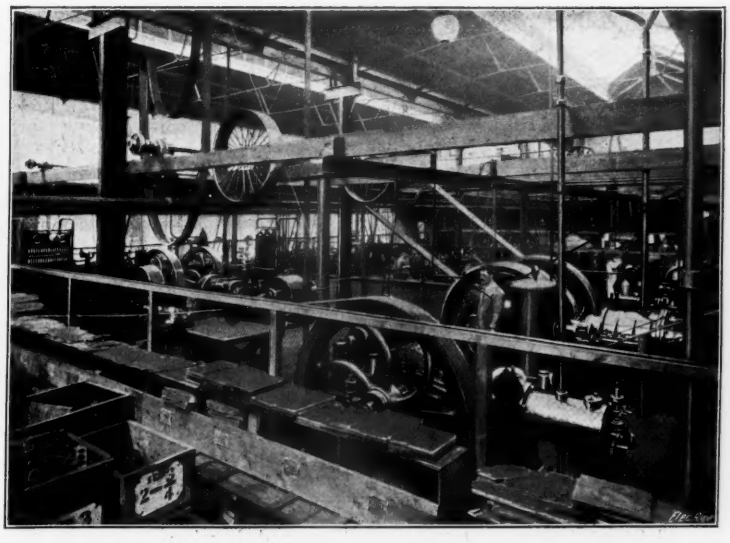
The Prometheus Assembling Room.

which steel conduits fill so large and important a place nowadays, is the new factory of Simplex Conduits, Ltd.; this is situated at Garrison Lane and Maxstoke Street, and covers an area of between 7,000 and 8,000 sq. yds. The building is of brick construction for outer and parting walls, the roof being supported by iron pillars and H-iron girders. The whole premises are lighted with arc and incandescent lamps supplied from the company's own power station. The building has been specially designed for the manufacture of conduits and fittings. There is one large central shop, the partitioning being of wood and galvanised iron netting; the subsidiary shops and stores surround the main shop. The total cost of the building and equipments was £28,000. The shafting is run overhead with patent clutch couplings which enable any department to be immediately and independently shut off should occasion arise. The machinery is partly driven by gas engines and partly by electric motors. The heating is by low pressure steam generated in an "Ideal" segmental boiler, 4-in. steam pipes being run through the shops.

The engine room contains three gas engines of 80, 40 and 25 H.P. respectively; also three Taunton dynamos, giving respectively 300, 200 and 120 amperes. The larger engine is fitted with a Parkinson patent anti-fluctuator, and is started by compressed air apparatus. The circulating water for all the engines is supplied from four large rectangular galvanised tanks fitted on the roof, each tank containing 1,300 gallons.

Simplex Conduit Works: The Split and Inspection Fitting Shop.

Simplex Conduit Fitting Shop.



The Power Plant at the Simplex Works.

All the repairs for the general upkeep of the factory are done in the fitting shop, and all tools both for use in the factory and for the purpose of re-sale are made there. The equipment of this shop comprises planing, shaping, boring and milling machines, four large screw-cutting lathes, three smaller lathes, patent gas muffle for tool tempering, and forge fitted with patent blower. There is over 1,600 ft. of belting in this shop, which is capable of employing from 30 to 40 hands.

In the boring and screwing shop all the fittings are bored and screwed before enamelling: it covers 266 sq. yds. and employs about 40 men. In its equipment there are seven large capstan lathes of latest design, six ordinary boring and screwing lathes, 18 vertical boring and screwing machines, six emery wheels, and two specially constructed tube bending machines. In this shop there are 2,000 ft. of belting in use. The principal machines are by Messrs. Alfred Herbert, of Coventry.

In the inspection and split fittings shop there are five power and hand presses for stamping, and five tapping and drilling machines.

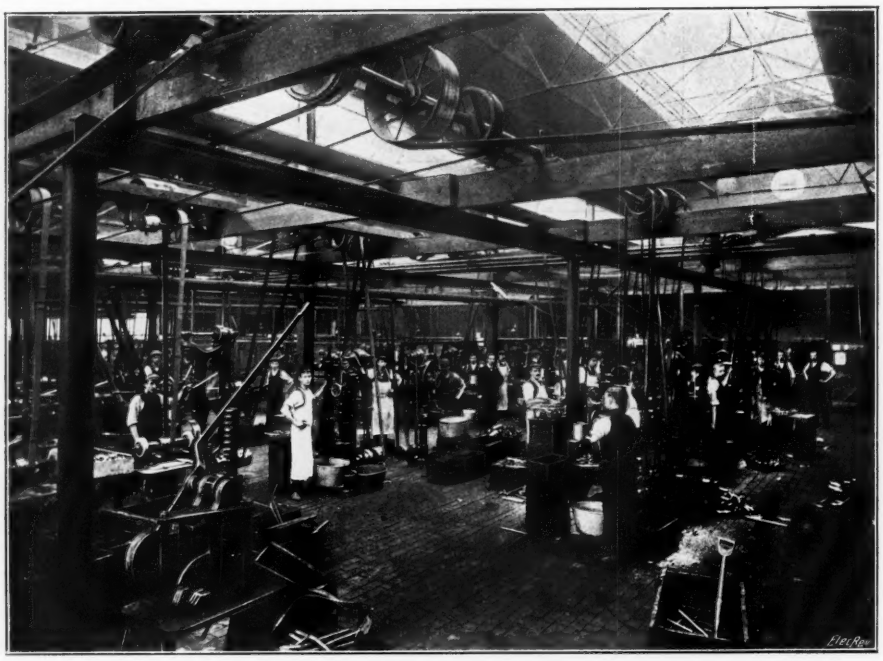
In the instrument shop between 20 and 30 hands are employed in the more particular work, such as the construction of main and sub-distribution boards, split fittings and electrolier work. All switchboards are also tested here for

insulation resistance. A special portion is set aside for experimental work, and the preparation of samples for agents' showrooms. This shop covers an area of 1,600 sq. ft. and contains a number of smaller tools.

In the pattern-makers' shop about half a dozen skilled men are mainly employed in making up patterns for all special work, which comprises a very fair proportion of the business.

The conduit screwing shop is situated next to the enamelling plant, and is equipped with half-a-dozen patent screwing machines, driven by electric motors. This shop is stated to be capable of turning out 25,000 ft. of screwed tube a day.

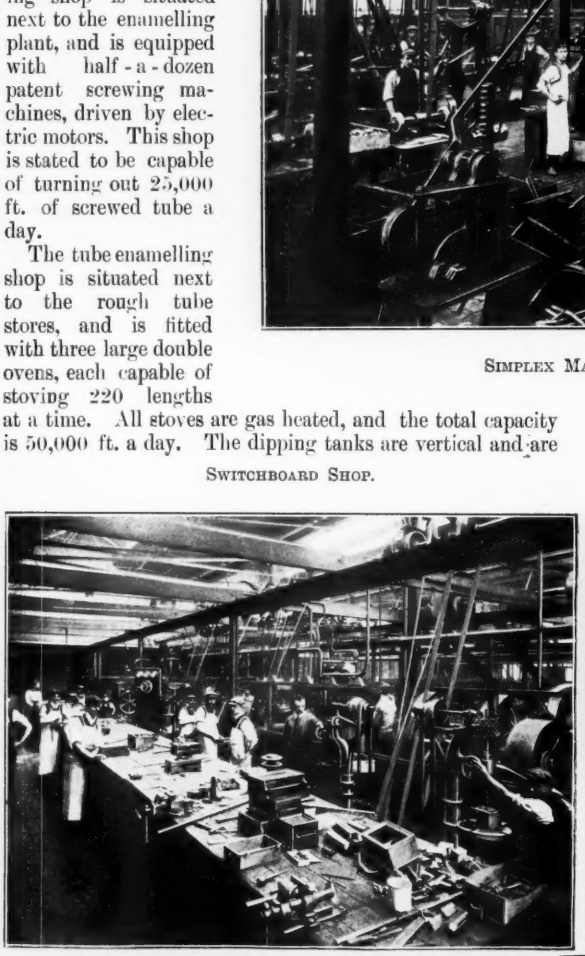
The tube enamelling shop is situated next to the rough tube stores, and is fitted with three large double ovens, each capable of stoving 220 lengths at a time. All stoves are gas heated, and the total capacity is 50,000 ft. a day. The dipping tanks are vertical and are sunk into the ground, and each contains about 600 gallons of enamel. There is an overhead runway on which the tube cages run on travellers, from which they are lowered into the dipping tanks.



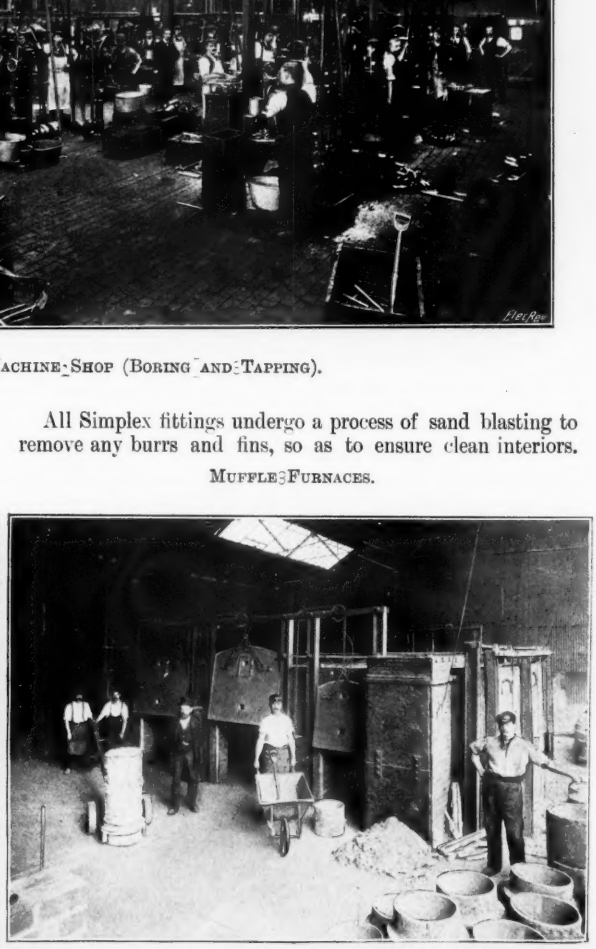
Simplex Machine-Shop (Boring and Tapping).

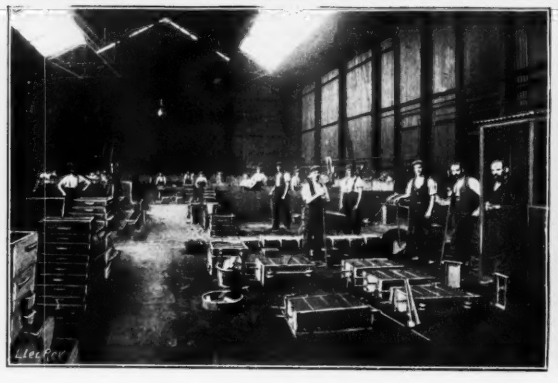
All Simplex fittings undergo a process of sand blasting to remove any burrs and fins, so as to ensure clean interiors.

Switchboard Shop.



Muffle Furnaces.





Iron Foundry.

Machine Moulding Shop.

The Simplex Conduit Works at Birmingham.

The sand blasting shop is equipped with a compressor, receiver and barrels, and the whole is driven by an electric

motor of 10 H.P. There is also electrically-driven machinery for finishing fittings before enamelling.

The foundry and annealing shops occupy an area of about 1,500 sq. yds., and the foundry is fitted up for malleable iron, common iron, and brass casting; it contains seven of the newest types of moulding machines and core-making machines, worked by hydraulic pressure. A pressure of 800 lb. per sq. in. is maintained by an accumulator, which in turn is fed by a double stroke force pump, and driven by a 5-H.P. electric motor. The floor space for common iron casting is about 250 sq. yds. Two cupolas are installed capable of melting 30 cwt. of iron per hour each; these are of an improved type with air blast driven by an electric motor and Roots blower taking 12 H.P.

Core-making shops containing suitable machines are also fitted, with benches, and eight men are employed continuously making cores by hand. There are three core ovens with a capacity from 400 to 1,000 cores each. The usual sand mills and barrels are installed and driven separately by a 10-H.P. motor.

The annealing plant consists of two patent ovens capable of annealing 20 tons of work.

There are in addition large stores for finished tube and fittings; these have direct access to the forwarding department, where there are two entrances for goods, inwards and outwards.

Commodious offices are situated above these departments, as is also a large mess room for the men and for the staff.

The various grades of conduit, solid-drawn, wire duct and brazed and ordinary Simplex are produced at a second factory which has been specially designed for the production of conduits for electrical circuits, this factory is situated within half-a-mile of the Simplex main factory where all the finishing processes are done. The company usually employs from 250 to 300 hands and keeps stocks of conduit material at the works and branches to the extent of £30,000 sale value, by which it is enabled to meet any demands.

Mr. L. M. Waterhouse, A.M.Inst.C.E., M.I.E.E., has been managing director of the company since its inception eight years ago.

TELEGRAPH and TELEPHONE NOTES.

(*Concluded from page 749.*)

Calcutta Telephones.—The telephone system is being converted from overhead to underground wires, at a cost of £50,000.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Cayenne-Pinheiro	Aug. 13, 1902	
St. Lucia-Martinique	May 7, 1903	
Dominica-Martinique	May 7, 1903	
Guadeloupe-Martinique	Aug. 29, 1906	
Mole St. Nicholas-Port au Prince	Aug. 16, 1906	
Curacao-Coro	Jan. 12, 1906	
Curacao-La Guayra	Jan. 12, 1906	
Curacao-Maracaibo	Jan. 12, 1906	
Reissa-Issa and Reissa-Yemani (Yemen)	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Port Arthur-Chifu (Closed)	Mar. 9, 1904	
Garachico Santa Cruz	July 12, 1906	
Las Palmas-Arecife	Aug. 18, 1906	
Landlines.		
Puerto-Barrios	Aug. 28, 1903	

Post Office Telegraphs.—According to a Parliamentary return issued this week, the total receipts for the year ended March 31st, 1905, were £3,920,023, and the expenditure exceeded this sum by £919,435. Adding to this the interest on the purchase money, the total deficiency for the year was £1,191,127.

Wireless Telegraphy.—An installation of wireless telegraphy is now complete between Hunstanton, on the Norfolk side of the Wash, and Skegness, on the Lincolnshire side, and messages have been satisfactorily exchanged. The Post Office will take over the working. The De Forest system has been adopted, and the stations will be placed in charge of men belonging to the coastguard. It is not intended to allow the public to use the service, their messages travelling by the customary land lines.

Mr. Marconi is in Milan, conducting experiments on the dirigibility of electric waves with a new apparatus.

CONTRACTS OPEN and CLOSED.

OPEN.

Accrington.—November 30th. Cables, troughing, bitumen; pole-work, overhead work, switch pillars; electric tramcars complete, for the Corporation tramways. See "Official Notices" to-day.

Barry Railway Co.—November 23rd. Stores and materials for one year, including electric incandescent lamps, wires and sundries. Forms, samples and patterns, &c., at the Storekeeper's Office, Broad Street, Barry.

Cape Town.—November 28th. Tenders will be received by the Chairman of the Tender Board, Cape Town, for the supply of dry cells, oblong, 3 in. by 1¾ in. by 6 in. high, regenerative or non-regenerative type, for the period February 1st to October 31st, 1907.—*Board of Trade Journal.*

Dublin.—November 19th. Stores for the Dublin United Tramways Co., Ltd. See "Official Notices" November 2nd.

Hackney.—November 22nd. One 1,500-KW. steam dynamo with accessories. See "Official Notices" October 26th.

Hungary.—November 15th. The municipal authorities of Veszprem are inviting tenders for the establishment of a central electric lighting station in the town.

Newport (Mon.).—It having been decided to obtain tenders for the supply of 48 lamp columns, the chairman of the Electricity and Tramways Committee was authorised to deal with the tenders.

Rome.—December 31st. The Municipal Council is inviting tenders for new street railways at Rome. Apply to the "Sindaco di Roma."

Spain.—November 20th. The municipal authorities of Aviles are inviting tenders until the 20th inst. for the concession for the electric lighting of the town during a period of 20 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Aviles, Spain.

Woodstock (Cape of Good Hope).—Tenders for the public lighting of the town. See "Official Notices" November 2nd.

CLOSED.

Birmingham.—The Corporation has placed a contract with Messrs. Berry, Skinner & Co. for a two years' supply of Berry's patent fool-proof motor-starting panels. We are informed by the Adams Manufacturing Co., Ltd, of Bedford, that these panels consist of a combination of "Igranic" starters with "Berry, Skinner" switch fuses.

Bristol.—The Electrical Committee has placed contracts as follows:—

British Westinghouse Electrical and Manufacturing Co.—Eight single-phase alternating current transformers, £592.

Babcock & Wilcox, Ltd.—Boilers, stokers, economisers, &c. (Avonbank, 3rd inst.), £20,075.

R. Wilkins & Sons.—Superstructure (Avonbank, 3rd inst.), £6,947.

Dublin.—The Corporation has accepted the following tenders:—

General Electric Co.—Meters.

Johnson & Phillips.—Arc lamps and pillars.

Curtis & Son, Dublin.—Copper feed water pipes.

Epsom.—The Lighting Committee of the U.D.C. has accepted Messrs. W. T. Henley's Co.'s tender for cable required for public lighting extension, at 1s. 11d. per yard for three-core ·012, ·008, ·012 cable, and 8s. 11d. per yard for triple-concentric ·15 and ·10 cable. This was the lowest tender.

Glasgow.—The Trustees of the Clyde Navigation have accepted the offer of Messrs. Siemens Bros. for the motor wiring and incandescent lighting in the power station at Clydebank Dock, at £198. The contract for electric cable required by the Trustees has been given to the Craigpark Electric Cable Co. Messrs. Haggie Bros.' offer has been accepted for wire rope for electric cranes.

The Parish Council has placed a contract for electric lamps and fittings with Messrs. Lowden Bros., at £465.

Greenock.—For the electric lighting of the District Hospital the Hospital Board has accepted the tender of Messrs. A. Anderson & Co., Greenock, at £770.

India.—The Empire Roller Bearings Co. have secured a further contract for fitting 60 heavy goods wagons with their roller bearing axle-boxes for use on one of the Indian railways. This makes 200 wagons fitted by them for the same company.

Leyton.—The T.C. has accepted the tender of Mr. J. Sayer, of Leyton, for the supply of tramcar destination boards, at £114.

London.—The Metropolitan Railway Co. has accepted the tender of Messrs. Johnson & Phillips, Ltd., for the supply of cables and wires for the ensuing 12 months.

L.C.C.—The Highways Committee of the L.C.C. propose to accept the offer of the Hadfield Steel Foundry Co. to supply, for a sum not exceeding £20,000, the special track-work required in connection with the construction or conversion of certain tramways to the conduit system.

Newport (Mon.).—The following tenders, being the lowest, have been accepted:—

General Electric Co.—Two boosters, one balancer, two-throw pump, £519.
Hayward, Tyler & Co.—One feed pump, £302.
William Sanders.—Two switchboards, £571 11s.

The tender of Mr. William Sanders is subject to the borough electrical engineer being satisfied with it, otherwise the next lowest one to be accepted.

Salford.—The T.C. has accepted the tender of Ferranti, Ltd., for ten 2-KW. transformers, at £9 each, and that of Messrs. Willans & Robinson, Ltd., for a pump for the condenser, at £45.

Walthamstow.—With reference to the list of the tenders for conduits for the U.D.C. (see page 716 of our last issue), it would be noted that the tender of Simplex Conduits, Ltd., was accepted, at the price of £46 18s. 7d., whereas the lowest other tender was over £70. The Simplex Conduits, Ltd., ask us to point out that the inquiry was misread by their head office, who quoted for ordinary socket material, and the offer was subsequently withdrawn.

West Bromwich.—The Electricity Committee has accepted the tender of Messrs. Johnson & Phillips, Ltd., for the supply of ·05 sq. in., ·25 sq. in., and ·3 sq. in. triple-concentric paper-insulated cable.

Worcester.—The City Council has accepted the tender of the Electric Construction Co., Ltd., for the supply of two 300-360-KW. alternators, complete with exciter, and coupled to two 350-440-KW. engines of Belliss & Morcom's make, with additional spares, fixed at the Hylton Road generating station, for £4,134, subject to the L.G.B. sanctioning a loan for the purpose.

York.—The Electricity Committee of the T.C. has accepted the tender of Callender's Cable & Construction Co., Ltd., for cable, at £379 10s.

FORTHCOMING EVENTS.

To-day's Events (Friday, November 9th).—At 8 p.m. Physical Society. Royal College of Science. Mr. G. F. C. Searle: Exhibit and Description of Experiments suitable for students in a Physics Laboratory.

At 8 p.m. Electro-Harmonic Society. "Ladies' Night" Concert.

Saturday, November 10th.—At 7.30 p.m. Birmingham and District Electric Club. Nomination of candidates for membership. Paper: "Arc Lighting," by Mr. J. W. Ewart.

Monday, November 12th.—Institution of Mechanical Engineers (Graduates). Meeting Institute of Marine Engineers (Junior Section). Lecture on "Electricity," by Mr. A. E. Battle.

Tuesday, November 13th.—At 8 p.m. Institution of Civil Engineers. Mr. C. F. Jenkin on "Single-Phase Electric Traction."

At 8 p.m. Faraday Society. At I.E.E. "Some Investigations Relative to the Depreciation of Electrolytically-produced Solutions of Sodium Hypochlorite," by Mr. W. Pollard Digby, A.M.I.E.E. "The Hermite Electrolytic Process at Poplar," by Mr. Chas. V. Biggs. "On the Electro-chemistry of Lead," by Dr. Alex. C. C. Cumming.

At 8 p.m. Institution of Electrical Engineers (Glasgow). Prof. F. G. Baily and Mr. W. S. H. Cleghorn on "Some Phenomena of Commutation."

Wednesday, November 14th.—At 7.30. p.m. Institution of Electrical Engineers (Students). Address by Dr. C. V. Drysdale on "The Electrical Industry at Home and Abroad.

At 8 p.m. Association of Engineers-in-Charge. Mr. J. Swinburne on "Indoor Illuminants."

Thursday, November 15th.—At 8.30 p.m. Chemical Society. Meeting.

Friday, November 16th.—Northampton Institute Engineering Society. Mr. T. Germann on "Telephone Sub-station Instruments."

At 8 p.m. Institution of Mechanical Engineers. Mr. Thos. Clarkson on "Steam as a Motive Power for Public Service Vehicles."

Saturday, November 17th.—At 10.30 a.m. I.E.E. (Students). Visit to the L.C.C. Greenwich Generating Station. The Northampton Institute Engineering Society has also arranged a visit to the same station.

THE ELECTRICAL ENGINEERS' R.E. (VOLS.).

THE following orders are issued:—

Monday, November 12th.—"A" Company, recruits' infantry drill, 6 p.m.; technical drill, 7 p.m.

Tuesday, November 13th.—"B" Company, technical drill, 6 p.m. Medical inspection for recruits, 7 p.m.

Thursday, November 15th.—"C" Company, technical drill, 6 p.m.

Friday, November 16th.—"D" Company, technical drill, 6 p.m.

WILFRID C. DUMBLE, Captain R.E., Adjutant,
For O.C.E.E.R.E. (V.).

NOTES.

Wireless Telephony.—The principal reason why all previous attempts made to solve the wireless telephony problem failed to give satisfactory results was the impossibility of producing electric waves of constant amplitude. This has, however, been quite recently achieved by Valdemar Poulsen, the inventor of the telegraphone, who has produced undamped electric oscillations of great intensity with the aid of what is called a "singing arc," by placing the latter in an atmosphere of hydrogen. These results have just been taken advantage of by Herr E. Ruhmer, of Berlin, the well-known experimenter in the field of wireless optical telephony.

Herr Ruhmer uses a sending apparatus, according to Poulsen, which comprises a "singing" arc placed in a hydrogen atmosphere and fed with direct current at 220 volts. The vibratory circuit is constituted by a capacity consisting of seven Leyden jars, an adjustable induction coil and the primary coil of a Tesla transformer. A high tension flaming arc several centimeters in length could be maintained between the secondary terminals of the transformer with suitable tuning. As this electric arc was examined in a rotating mirror, it was found to have the appearance of a direct current arc. An oscillograph glow tube inserted in the secondary circuit of the transformer showed in the rotating mirror a uniform glowing surface limited by two straight lines parallel to the zero line and situated at equal distances from the latter.

This observation induced Mr. Ruhmer to alter the generator of waves in the same way as a "speaking" arc lamp. The throttling coil previously inserted in the feeding circuit of the arc, which was intended to prevent any reaction of the rapid oscillations on the direct current circuit, was replaced by an induction coil, the secondary winding of which was connected to a microphone and battery. On talking into the microphone, the oscillograph glow tube was found to show a glowing band of variable luminous intensity with indentations corresponding to the sound waves, showing the intensity of the high-frequency currents in the secondary of the transformer to be influenced in a way which exactly corresponded to the spoken words. These effects seemed to depend on alterations in both the wave length and intensity of the electric oscillations. Whenever a flaming arc in the place of the glow tube was fed with the undulating high-frequency currents this would clearly and distinctly render any word spoken into the microphone with an intensity even superior to that of ordinary direct-current "speaking" arcs. Herr Ruhmer then used a similar arrangement for transmitting the human voice with the aid of electric waves, an electrolytic cell serving as wave detector. Experiments so far made have been confined to the inventor's laboratory, and the results obtained over distances of about 30 metres with the aid of an aerial 1½ metres in length are highly satisfactory. These investigations are being continued with aerials of greater length, it being hoped to transmit conversation to distances of several kilometres.—A.G.

Royal Commission on Canals.—The Royal Commission sat on Wednesday at the Westminster Palace Hotel, under the chairmanship of Prof. Shuttleworth. Mr. Gordon Thomas, representing the Grand Junction Canal Co., advocated the placing of the main canals of the country under one control, particularly those between London and Liverpool and Hull and Bristol, and also the increase of the width and depth of the canals to allow of modern means of traction.

Prof. Marchant, of Liverpool University, representing the London Chamber of Commerce, was in attendance all day to give evidence with regard to the question of electric haulage, but the examination of the first witness occupied so long that there was no time to call him, and a future date will, therefore, have to be fixed for his examination.

Electrical Production of Steel.—The Styrian (Austrian) cast-steel works of Danner & Co., which form part of the Wittgenstein group, have concluded an agreement with the Electro-Steel Co., of Remscheid, for working the Héroult process on licence. The Aluminium Co., of Neuhausen, Switzerland, is also interested in the process, and a further licence has likewise been granted to a Swiss firm, whose name is not mentioned. In Germany the right for the electro-thermic production of iron and steel by the Héroult method is exercised by the steel works of Richard Lindenberg & Co., of Remscheid, who are said to make all the steel they require according to this system. This company, notwithstanding the costly experimental work undertaken during the past 12 months, are reported to have been so successful that a dividend at the rate of 8 per cent. is expected to be paid for the year.

Electro-Chemical Notes.—Electrical Smelting of Iron and Steel under Pressure.—In an article upon the electrical manufacture of iron and steel, recently printed in the *Chemiker-Zeitung*, Herr Carl Otto points out the advantages that should follow from keeping the furnace under a pressure exceeding that of the atmosphere. When the electrical process was first considered, it was thought that owing to the absence of impurities due to foreign matter in the metallurgical coke or coal, and to the absence of oxygen from the furnace, the ores would be more perfectly reduced, and the iron would be purer than that hitherto prepared. These hopes, however, have not been altogether fulfilled. Electrically reduced iron is not pure, and some of the metal is re-oxidised. The cause of the incomplete reduction is the chemical equilibrium which sets in at the high temperature, and the cause of the re-oxidation is the dissociation of the carbon monoxide. There is always an excess of carbon in the electric furnace, some of which comes from the decomposed carbon monoxide; and, therefore, in those processes where no slag is present, a pig-iron is produced instead of a malleable iron, while in the presence of slag (as in the Stassano furnace) carburisation of the metal is only prevented because a kind of Martin process goes on underneath, consuming the carbon and leading to the desired reduction, but leaving an iron contaminated with harmful impurities.

The question thus arises: How can the excess of carbon present be compelled to react with the carbon dioxide which has been produced, so as to form fresh carbon monoxide in a sufficiently rapid manner at the high temperatures now employed? The experiments carried out by Dumas years ago showed that at a red heat carbon would reduce carbon dioxide if the gas were led over it slowly; but that if a current of carbon dioxide were led in similar conditions over a mixture of iron borings and filings only 80, and sometimes only 50, per cent. of the gas by volume was converted into monoxide. Recently Farup has shown that the reaction between carbon and carbon dioxide begins at 810°, and becomes more rapid at 850° C. Although the temperature of the electric arc is much above the figures mentioned, the greater heat will not overcome the slowness of the reaction between carbon and carbon dioxide, because the velocity of the reaction depends on mass action; but an increase of the pressure will cause a larger quantity of the gas to act upon the carbon. The conditions which it is desirable to realise in the furnace are, therefore, a temperature below 1,000° C., and a pressure exceeding that of the atmosphere, as well as an excess of carbon. In these circumstances the carbon monoxide is assisted in its endeavours to combine with the oxygen of the ore, and the greater partial pressure of the resulting carbon dioxide helps it to react with the excess of carbon, producing more monoxide. A considerable excess of carbon is necessary, because in reacting with the dioxide to form monoxide, it has to afford an amount of heat equal to that which is rendered latent as the latent heat of carbon vapour, viz., 3,134 calories per kilogramme. The temperature in the furnace tends to become higher towards the close of the reduction, increasing the *vis viva* of the gases, and so the carbon dioxide becomes less and less likely to be reduced by the carbon; but if the process is carried out under pressure better opportunities of reduction are given to the dioxide, and so it is hindered from oxidising the iron that has already been converted into the metallic state.

For these reasons it is convenient to construct the furnace with a "pocket" in which the large excess of carbon can be stored, for it is then out of contact with the slag and cannot reduce the silica and phosphoric acid. If the whole process is carried out under pressure, that is to say, under constant volume, the carbon monoxide which finally escapes from the reducing vessel being burnt underneath under pressure, and led away while still under pressure, the operation is rendered highly efficient, and bars of steel introduced to form a liquid bath for the collection of the finely-divided reduced iron are rapidly melted. In fact, the apparatus is then in reality a kind of melting furnace, the waste heat of which is employed to reduce ores. Being still under pressure, the furnace gases can easily be made use of in various directions.

Vertical Arc Furnaces for the Laboratory.—According to S. A. Tucker (*Electro-chemical and Metallurgical Industry*, Vol. IV, No. 4), a useful form of arc furnace constructed on the Willson pattern may be constructed in a very short time from Acheson graphite. The crucible is scooped out of a solid electrode 5 in. in diameter, and is connected at the bottom by means of a thread to a horizontal electrode 32 mm. in diameter. The walls are left about 20 mm. thick, and are protected externally by means of powdered slaked lime, and finally by bricks. The arc is struck from a central electrode 32 mm. in diameter, and the mouth of the furnace is covered with a plate of suitable material. This form suffers, however, from unequal heating and from local high temperatures, which causes volatilisation and consequent loss of material. A more convenient form is of the Moissan type. The connection between the crucible and the electrode is made by means of a plate of graphite fitted on the crucible. At the bottom of the crucible a plug of asbestos is placed, raised slightly above the surface of the charge to protect this latter from direct contact with the arc, which is struck from the internal electrode to the plug. The charge is thus heated by radiation, and soon reaches a uniform temperature; 2,000° C. may be maintained at the charge space, using a current of about 350 amperes with a drop of 35 volts across the furnace.

The Free Labour Congress.—At a time when the rights and privileges of Trade Unions are kept prominently before the public by persons who have thrown in their lot with these bodies, it is a welcome relief to hear something of the "unorganised labour" movement. At the fourteenth annual congress of the National Free Labour Association, which was opened on October 29th, the fact was brought to light that 60,000 workers of all trades and occupations had during the year registered themselves in the association's books as being open to employment. The association in 14 years has enrolled upwards of 600,000 workers, and has defeated 546 senseless strikes, with the result—according to the report of the general secretary of the Congress—"that the trade unions had suddenly been converted to the opinion that fighting was a very disastrous proceeding for both parties." Some of the figures which are given in the report are of considerable interest. During the year 1905-6, the amount of time lost by strikes was enormous, and was equal to nearly 2½ million working days. Large though this number was, it only amounted to about a quarter of a day per head, when spread over the whole industrial population of the country. Most of the disputes arose over questions of remuneration, and in the engineering and shipbuilding trades, it appeared that of the 53 disputes, 27, involving 62 per cent. of the total number directly affected, arose on questions of wages. Taking all the wages disputes of the year, only 14 per cent. of the workpeople directly affected were successful, 57 per cent. were unsuccessful, and 29 per cent. arranged compromises.

We may conclude this notice by referring to the views of the President of the Congress upon the Trades Disputes Bill, which is now before Parliament. He said the Bill was nothing if not a measure to grant a licence to associations of men to trample on the inherent rights of the individual. It sought to establish the fear of the mob, as pickets, in intimidating free labour, and in compelling employers to yield to trade union demands. It was in effect a measure for the establishment of Socialism on a militant basis.

Electrical Power Schemes in the Transvaal.—It was recently mentioned, in connection with the scheme for the electrical transmission of power from the Victoria Falls of the Zambesi, that it was proposed, in the first place, to establish a large steam power-generating station on the Witwatersrand, and to deal with the Victoria Falls scheme for the conveyance of energy to the Rand district at a later period. On this subject, a Johannesburg correspondent of the *Frankfurter Zeitung* states that there has been a gradual reduction in the data relating to the utilisation of the water-power of the Victoria Falls for the production of electrical energy. As is known, the water rights in the falls have belonged for years past to the African Concessions, Ltd., but the company has not done anything with them. The scheme has now arisen for the transmission of power to the Rand. It seems, however, doubtful to every intelligent person, the correspondent proceeds to remark, whether the falls could really yield the proposed 15,000 H.P. during the dry season. In addition to this, there has to be considered the heavy loss of power in transmission to the Rand, and the constant danger of damage to which conductors passing over an unpopulated wilderness of 806 miles would be exposed. As a consequence, the necessity has been already admitted in Johannesburg of simultaneously establishing a power station with steam plant in the vicinity of the Rand, and as this would probably be too expensive merely as a reserve, it will, perhaps, in reality happen that a new power station, with steam plant, will simply be erected near the Vereeniging coal mines on the Vaal River, as has been suggested. A similar station already exists in the Rand Central Electric Works, on the east of the Rand, near Brakpan, although it remains undecided whether there is room at present for two stations. The correspondent adds that the European newspapers recently reported that the Legislative Council at Pretoria had adopted a Bill granting to the African Concessions, Ltd., the right of way and expropriation in the whole of the Transvaal for the purpose of laying cables, but the truth is that the Bill was withdrawn as having no prospect, and it was not even given consideration. The Governor was only authorised by the Legislative Council to grant, as cases might arise, rights of way, rights for crossing railways, and building sites for industrial undertakings. This authority refers not only to the company, but also to any other applicant for such rights.

Parliamentary.—The Metropolitan Electric Supply Co.'s Bill for power to extend its area of supply so as to include New Windsor, Rickmansworth, Chorley Wood, Chesham, Beaconsfield, Slough, Amersham, Eton, Wycombe, &c., and to alter the Act of 1890 by relieving the company from the obligation in relation to Paddington, should, on Tuesday, have come before a Select Committee of the House of Lords, but (according to the *Financial News*) before the hour of meeting all opposition was withdrawn, and the Bill was referred to the Select Committee on Unopposed Bills.

On Wednesday last the Administrative County of London and District Electric Power Bill was down for second reading in the House of Commons, but was withdrawn.

The Electro-Harmonic.—Readers are reminded that to-night is a Ladies' Night at the Electro-Harmonic Society. Dr. R. T. Glazebrook, the President of the Institution of Electrical Engineers, will be in the chair. Some particulars of the programme were given in our "Notes" last week.

Electric Shock Case at Bradford.—The hearing of this case, to which we referred in our last issue, page 718, has resulted in a verdict for the Corporation. His Honour said he could not say without further evidence that the examination of the equipment had not been made reasonably often enough, and he, therefore, gave judgment for the Corporation.

A Swiss Water-power Station.—The undertaking known as the Kubel Electricity Works, of Herisau, has been in existence since 1898, and now has a large sphere of activity. The company works hydro-electric plant at the so-called Kubel on the Urnasch and Sitter, in the cantons of Appenzell and St. Gall, and the concessions for this purpose, which mainly have a currency of 50 years, were acquired partly from an Austrian and partly from the Governments of the two Cantons. The central station at Kubel comprises seven turbine sets, of a total output of 7,200 H.P., and reserve steam plant of 1,000 H.P. It is proposed next year to substitute for three of the turbo-generators sets of 500 H.P. three of 1,000 H.P. each, and to install a second reserve steam set of 3,000 H.P., thus bringing the total capacity up to 12,700 H.P. The extent of the system of supply is shown by the fact that the station serves no fewer than 34 different localities by means of 194 transformers of a total power of 6,667 KW., which receive energy from a high pressure network extending over 90 miles. The company paid a dividend of 6 per cent. for 1905-6, as compared with 4½ per cent. in the preceding year, and a fresh increase in capital has just been made in order to defray the cost of the contemplated extensions. The share capital now amounts to £170,000, and the loans raised also represent the sum of £170 000.

Institution and Lecture Notes.—THE ASSOCIATION OF ENGINEERS-IN-CHARGE.—Last Saturday the above Association held its first social (dance) of the session at its headquarters, St. Bride's Institute, Bride Lane, E.C., which event proved to be a decided success. The programme of dances was under the direction of Mr. Hardy, the Association's musical director.

On Monday last Madame Curie commenced a series of lectures at the University of Paris, in her capacity of Professor of Physics.

INSTITUTION OF ELECTRICAL ENGINEERS.—The eighteenth annual dinner is to be held in the Grand Hall of the Hotel Cecil, on Tuesday, December 4th.

I.E.E. (DUBLIN).—The opening meeting of the Session is to be held on Thursday, November 22nd, at the Royal College of Science, St. Stephen's Green, at 8 p.m., when Mr. A. W. Whieldon, chairman, will deliver his inaugural address.

I.E.E. (BIRMINGHAM).—The first meeting of the Birmingham Local Section this Session will be held on Wednesday, November 21st, at 8 p.m., at the University. The chairman, Mr. R. A. Chattock, will deliver his address.

I.E.E. (MANCHESTER).—The following is the programme for the 1906-7 Session :—

November 20th.—Mr. T. L. Miller—Chairman's address.
December 4th.—Mr. Miles-Walker on "Rotary Converters *v.* Motor Generators."
December 18th.—Mr. J. H. C. Brooking on "Cheapened Methods of Electrical Distribution."
January 8th.—Mr. W. Cramp on "Magnetic Leakage and its Effect upon Electrical Design."
March 19th.—Mr. L. J. Hunt on "A New Type of Induction Motor."
April 2nd.—General meeting. Mr. C. F. Smith on "Some Experiments on the Internal Losses in Motors."
January 22nd.—Mr. G. W. Worrall on "Magnetic Oscillations in Alternators, and their Bearing upon the Design."
February 5th.—Mr. C. E. Douglas on "Gas Power Plants."
February 19th.—Mr. A. P. Wood on "Some New Fly-Wheel Storage Systems."
February 22nd.—Annual dinner.
March 5th.—Mr. Llewellyn Foster on "Breakdowns of Electrical Machinery."

Wireless Telegraphy.—The correspondence on this subject was continued last week, "Colonist" writing to the *Morning Post* of Friday last to explain the importance of wireless telegraphy to Canada, round the coasts of which there is a long chain of stations of high efficiency and of immense service to navigation. These stations are owned and controlled by the Dominion Government, though they are worked by the Marconi Co. It is alleged that the admission of stations on various systems round the British coasts will result in interference fatal to efficiency, and the writer complains that the British Government did not consult with the Colonies before settling its policy—a supposition which we believe to be mistaken. Mr. Charles Bright also wrote, generally approving of Mr. Nevil Maskelyne's letter, and contending that fair and open competition had been non-existent in this country. He advocated exhaustive and impartial trial of all British systems under like conditions.

In the *Times* of November 3rd the Marconi Co. had a lengthy letter urging that Great Britain should withdraw from the conference, and deprecating the establishment of stations for foreign utility on British coasts. In the following issue, "X" suggests that the company's alarm is prompted by solicitude for its own ends, and takes the view that ample safeguards have been secured for national interests.

British Westinghouse Electric and Manufacturing Co., Ltd., v. The Town Council of Aberdeen.—At the Edinburgh Court of Sessions on 2nd inst. this case was heard. According to a report in the *Scotsman*, the petitioners, in February 1904, entered into a contract with the respondents for the erection of an additional engine and dynamo for the Corporation Electricity Works. The contract contained an arbitration clause which referred all disputes, other than questions relating to the rejection of material, to Mr. Chamen, then electrical engineer to the Corporation of Glasgow, whom failing, to "the engineer for the time being." In October, 1904, while the engine was being erected, the fly-wheel sustained a radial crack in the web as it was being forced on to the crankshaft. The respondents' engineer at once intimated that a new fly-wheel would have to be supplied, and meantime the cracked fly-wheel was used to run the engine. The petitioners refused to supply a new wheel, and the respondents ultimately had the cracked one removed, and a new one substituted, and they claimed to be allowed to deduct the expense of the new wheel from the contract price. The petitioners maintained that the crack in the wheel in no way affected its usefulness, and they presented the present application for the appointment of an arbiter, under the Arbitration Act of 1894, founding on the arbitration clause in the contract, and setting forth that both Mr. Chamen and his successor in office had declined to take up the reference. The respondents opposed the petition, and maintained, first, that on Mr. Chamen declining to act, the proper arbiter was the respondents' own engineer; second, that the reference not being to an unnamed arbiter, the Arbitration Act did not apply; and, third, that the whole question was one, not for the arbiter, but for the respondents' engineer under the clause entitling him to reject faulty material.

Lord Dundas, in giving judgment, sustained the whole of the respondents' contentions, and dismissed the petition with expenses.

New Fluorescent Material.—In the *Archives of the Roentgen Ray*, Dr. F. F. Strong recently described a new material for coating fluorescent screens for use with the X-rays. The cyanide of barium and platinum screens are costly, and lack permanency of fluorescence, the average life being four to six months, but they are the best obtainable. Dr. Strong, however, has succeeded in producing a hard, permanent screen, with a fluorescence second only to that of a freshly coated cyanide screen, and of lighter colour, while the price is halved. The substance employed is a compound of willemite (impure zinc silicate) and artificially produced zinc silicate. Water, steam, heat, cold and sunlight have no effect upon its properties.

Extra-high-high-pressure Lines.—The constantly increasing pressures employed for electric power transmission lay under stress not only dielectrics, but also the English language. Experiments have been carried on for the past six months by a German firm for the purpose of testing ambroin insulators at a pressure of 100,000 volts, in the open air and passing through a wall into a building. Apart from interruptions due to surges, set up by abrupt changes of the regulating apparatus, and completely overcome by the use of a variable inductance regulator, the installation has worked well. The aerial wires become luminous at 40,000 volts, and a crackling sound is heard; at 100,000 volts practically all the charged conductors are luminous, up to the terminals of the transformer.—*L'Industrie Electrique.*

The firm of Pirelli & Co. has recently been entertaining the visitors to the Exhibition at Milan by conducting experiments at 320,000 volts, operated from machinery of 200 H.P. These experiments proved intensely interesting to the members of the Italian Electro-Technical Congress during their recent visit to the Exhibition. The experiments were under the direction of Engineer Jona, who succeeded in designing an electrostatic voltmeter capable of indicating up to 200,000 volts. Some of the cable, which was tested up to 100,000 volts, was from the bulk manufactured by Messrs. Pirelli for the Trentino transmission line. Other tests were carried out on aerial lines, over a length of 160 metres, supported on large Ginori insulators; at 240,000 volts there was very lively crackling, and the whole length of line became luminous, notwithstanding the fact that it was impossible to cut off a good deal of external light.

Another experiment was conducted on a rotating body, the periphery of which was moving at a velocity of 60 metres per second, whilst rotating at 1,200 revolutions a minute; in the darkness the luminous discharges appeared to rotate slowly in a contrary direction, and it formed an extremely interesting and picturesque experiment.

To guard against surges in high-pressure electric lines, the Land und Seekabelwerke A.G., of Cöln-Nippes, have introduced a device designed to enable horn arresters to be used with a wide gap on ordinary circuits without loss of sensitiveness. The essential feature of the device is a high resistance by-pass to the gap, containing a narrow gap between two platinum points. A rise of pressure on the line causes a slight discharge between these points, which are close to the main gap; and the air in the latter being thus ionised, permits the discharge to take place freely across it. Special resistances for insertion in the earth-line are made by the same firm.

Appointments Vacant.—Telegraph inspector for Nigeria (£250); junior lecture assistant for the electrical engineering department at the Northampton Institute.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station Engineers.—The staffs of the Electricity and tramway departments at Swindon on October 31st presented a stop watch to Mr. J. G. GRIFFIN, electrical engineer, in view of his approaching departure.

Mr. CECIL F. BUTTON, of Plymouth, has been appointed charge engineer at the Peterborough Corporation Electricity Works, from Plymouth.

The Wallasey U.D.C. has fixed the maximum salary of the electrical engineer at £500 per annum, and that of the tramways general manager at £500. The salary of the latter, Mr. R. R. Greene, has been increased by £25 per annum.

Mr. F. Charlesworth has resigned his post as engineer-in-charge of the Corporation electric lighting station at Portsmouth, in order to take up an appointment abroad. Before leaving, he was presented with a watch by Mr. W. S. Foale, engineer and manager on behalf of the works staff.

The Lighting Committee of Dublin has recommended a re-arrangement of the terms of appointment of the superintendent of the Pigeon House electricity station; also the permanent appointment of Mr. Laurence J. Kettle to the position.

Tramway Officials.—The Leyton U.D.C. has appointed Mr. D. C. McLean, of Croydon, as tram-shed foreman.

General.—The Royal Society has just awarded the following medals:—The Rumford Medal to Prof. Hugh Longbourne Callendar for his experimental work on heat; a Royal Medal to Prof. Alfred George Greenhill for his contributions to mathematics, especially the elliptic functions and their applications; the Davy Medal to Prof. Rudolf Fittig for his investigations in chemistry and especially for his work in lactones and acids; the Hughes Medal to Mrs. W. E. Ayrton for her experimental investigations on the electric arc, and also upon sand ripples. The medals will be presented at the anniversary meeting on November 30th.

Rear-Admiral H. B. Jackson, who has just been promoted to that rank, is an expert electrician. Amongst the appointments which he had filled, were those of secretary to the Committee on the Designs for Wireless Telegraphy for Naval Purposes, and chairman of the Electrical Committee on the Equipment of Warships. In 1901, he was made a Fellow of the Royal Society, in recognition of his researches in electrical physics. He saw service in the Zulu War, 1878-9.

Mr. T. Rowe, who has been for 25 years in the service of the National Telephone Co., has been presented by the staff of the company at Liverpool, with a tea and coffee service, and with a gold chain for his wife, on his retirement. The presentation was made at a smoking concert held by the staff, at St. George's Restaurant, Liverpool, by Mr. H. Claxton, local director of the company.

The *Times* says that on Tuesday, Mr. J. A. F. Aspinall, general manager of the Lancashire and Yorkshire Railway, was appointed chairman of the General Managers' Conference for the ensuing year.

Mr. Herbert Leslie Langford, chief electrical engineer to the Powell-Duffryn Co., New Tredegar, who is leaving to take up a similar appointment at Kenfig Hill, has been presented by his colleagues with a silver mounted tobacco pouch, set of pipes, and an ebony walking stick.

The Reigate T.C. has appointed Mr. E. A. Ingold, of Hornchurch, as commercial agent in connection with the electricity works at a salary of £2 per week.

Mr. Arnold Lupton, M.I.C.E., M.I.E.E, notifies that his address is now 7, Victoria Street, Westminster.

Mr. G. E. Sanders, A.M.I.E.E., A.M.I.M.E., who has recently been acting as inspector of electrical installations in the East London and King Williams Town Districts for the Frontier Fire Insurance Association, has been appointed chief assistant to the municipal electrical engineer at Port Elizabeth.

Mr. E. S. Conradi, electrical engineer to Messrs. Bruce Peebles and Co., Ltd., on their Falkirk and District Tramways contract, was recently presented with a smokers' cabinet by his many friends as a token of esteem on his leaving Falkirk for London.

Messrs. Masons Gas Power Co., Ltd., announce that Mr. Charles Guest Norris's engagement as general manager of this company has been terminated. Mr. Thomas Wright, who has hitherto acted as works manager, has been appointed general manager of the company.

Mr. Frederick Cortez Leigh, who has just been gazetted as Consul of Panama in Manchester, is a partner in the well-known firm of Messrs. Lacey, Sillar & Leigh, consulting electrical engineers, of Westminster and Manchester. The *Manchester Courier*, in announcing this fact, says that Mr. Leigh has recently returned from a tour in South America, where he gained considerable knowledge as to the prospects of electrical and general engineering work in that country. Owing to his being thoroughly conversant with the Spanish language he was able to come in touch with most of the leading men in various South American States in connection particularly with tramways and other electrical undertakings. Mr. Leigh was very fortunate in visiting the South American States at a time when the general tendency there was to take a lead from this country in regard to electrical enterprise. He was bombarded with questions as to work in this country, and the information and knowledge he was able to obtain must be the means of strengthening, and in its results materially assisting, the commercial interests and welfare of this country and the various Republics.

Mr. Hugh S. Davidson has resigned his position as chief engineer to the electrical works department, Army and Navy Aux. C. S., Ltd., and has this week taken up his new duties as Irish manager for Messrs. Handley & Shanks, of 12, Dawson Street, Dublin.

Obituary.—The death occurred on November 2nd, at his shooting-box at Putteridge, near Luton, of Mr. George Herring. He was 74 years of age, and death followed an operation for appendicitis. For many years he had been on the boards of various London electrical companies, including the Electric and General Investment Co., Ltd., and the City of London Electric Lighting Co., Ltd. Further reference to his connection with electrical companies appears in our "Stocks and Shares" article.

NEW COMPANIES REGISTERED.

Percival Spencer, Ltd. (90,324).—This company was registered on October 2nd, with a capital of £1,000 in £1 shares, to take over the business of engineers and machinery merchants and agents carried on by Percival Spencer, Ltd. (in liquidation), at 32, King Street West, Manchester, and to carry on the business of electric telegraph, telephone and general engineers, cable makers, manufacturers of dynamos, electric lighting, power and transmission plant, &c. The first subscribers (each with one share) are:—A. J. Jones, Nassau House, Ellesmere Park, Eccles, engineer; P. Spencer, 5, Albert Terrace, Old Trafford, engineer; B. Collier, 3, York Street, Manchester, F.C.A.; L. Greenhalgh, 3, York Street, Manchester, A.C.A.; H. H. Evans, 3, York Street, Manchester, A.C.A.; W. Jones, Nassau House, Eccles, gentleman; and D. F. Hart, 18, Tib Lane, Manchester, solicitor. No initial public issue. Table "A" mainly applies.

Franklin & Isaacson, Ltd. (90,404).—This company was registered on October 12th, with a capital of £5,000 in £1 shares, to acquire the business of electrical, mechanical and consulting engineers carried on by H. Franklin and R. J. Isaacson at 18, Great Wilson Street, Leeds, as "Franklin & Isaacson," and to carry on the same and the business of mechanicians, founders, manufacturers of locomotives, propellers, dynamos, electrical plant, engine governors, mining machinery and batteries, &c. The first subscribers (each with one share) are:—H. Fenton, Chidswell, Dewsbury, manufacturer; A. L. Scarr, Chidswell House, near Dewsbury, general merchant; S. E. Freeman, 15, Park Row, Leeds, insurance official; R. J. Isaacson, 12, Ash Grove, Headingley, Leeds, engineer; D. H. Simpson, Standard Buildings, City Square, Leeds, engineer; T. Wood, 8, Haddon Place, Leeds, clerk; A. G. Carter, Wigton, near Leeds, clerk. No initial public issue. The number of directors is not to be less than three or more than five; the first are R. J. Isaacson, H. Fenton and A. L. Scarr; qualification, £250; remuneration as fixed by the company. Registered office, Great Wilson Street, Leeds.

Copingers, Ltd. (90,438).—This company was registered on October 15th, with a capital of £2,000 in £1 shares, to acquire the business of electrical engineers and contractors carried on as "Copinger & Co.," and to carry on the business of electricians, suppliers of electricity, contractors for electric lighting, heating, power and ventilating plants, electric motors and generators, telephones and electrical apparatus generally, &c. The first subscribers (each with one share) are:—C. A. de B. Copinger, 186, Ayres Road, Old Trafford, electrical engineer; F. J. McElroy, 48, Wyatt Street, Heaton Norris, Stockport, electrical engineer; H. B. Copinger, Monton House, Kersal, bar student; G. H. White, 54, Palatine Road, Northenden, Ches., electrical engineer; S. Thompson, 12, Athol Road, Alexandra Park, Manchester, printers' engineer; G. S. Viney, 33, Derby Street, Moss Side, Manchester, electrical engineer; and T. Baskerville, Lonsdale, Slade Lane, Levenshulme, Manchester, publisher. No initial public issue. The number of directors is not to be less than two or more than five; C. A. de B. Copinger is manager for life with not more than £400 per annum. Registered office, 43, Lower Mosley Street, Manchester.

Vaughan & Cook, Ltd. (90,514).—This company was registered on October 20th, with a capital of £7,000 in 6,975 preference shares of £1 each and 500 ordinary shares of 1s. each, to carry on the business of electric light, gas, hot water and ventilating engineers, manufacturers of and dealers in metal and other engineering work, motors, batteries, arc and incandescent gas, oil and electric light fittings, &c., and to acquire the leasehold premises, Nos. 298A to 300A, Goswell Road, London, and the business carried on there as Bolton, Fane and Co. The first subscribers (each with one ordinary share) are:—T. W. Vaughan, 27, Lloyd Square, W.C., engineer; A. L. F. Cook, 37, Great Cumberland Place, W., engineer; Mrs. R. Vaughan, 27, Lloyd Square, W.C.; Mrs. E. M. Cook, 37, Great Cumberland Place, W.; R. H. Jones, The Laurels, Newlands Park, Sydenham, gentleman; P. Gimber, 12, Cranston Road, Forest Hill, S.E., clerk; G. J. Marr, 30, Cornford Grove, Balham, S.W. clerk; W. G. Mercer, Endsley, West Drayton, Middlesex, gentleman; C. E. Allender, 6, Baalbee Road, Highbury, accountant; and G. Clarke, 153, Sumner Road, Peckham, S.E., clerk. No initial public issue. The number of directors is not to be less than two or more than five; the first are A. F. L. Cook and T. W. Vaughan (both permanent managing directors); qualification, 10 shares. Registered office, 298A to 300A, Goswell Road, E.C.

Dynelectron Syndicate, Ltd. (90,570).—This company was registered on October 26th, with a capital of £10,000 in 9,900 "A" shares of £1 each, and 8,000 "B" shares of 3d. each, to acquire an option to purchase certain existing inventions relating to the generation of electricity, known as "Dynelectrons," and to carry on the business of electricians, suppliers of electricity for light, heat, motive power or otherwise, manufacturers of and dealers in electrical apparatus, &c. The first subscribers (each with one share) are:—A. L. Lambert, 7, Oval Road, Regent's Park, N.W., director; A. Ireland, 58, Blenheim Road, Walthamstow, clerk; Minnie Tromm, 66, Cricketfield Road, Lower Clapton, typist; H. A. Kidd, 100, Huntington Road, East Finchley, chartered secretary; C. E. Warren, Zedeico, Harrow Lane, Maidenhead, engineer; W. Skinner, 6, Throgmorton Avenue, E.C., F.C.I.S.; and H. H. Syms, 70, Queen Victoria Street, E.C., solicitor. No initial public issue. The number of directors is not to be less than two or more than five; the subscribers are to appoint the first. The "A" shares entitle the holders to all the profits available for dividend in each year, until the total dividends paid amount to 100 per cent., and thereafter the profits shall be divided as to half among the "A" shares if the whole of the "A" shares are issued, or otherwise, in proportion to the number issued, and the remainder among the "B" shares.

Formby and Freshfield Electric Light Co., Ltd. (90,510).—This company was registered on October 20th, with a capital of £25,000 in £1 shares, to adopt agreements (1) with the Formby Union District Council (2), with the Northern Electrical and Ventilating Co., and (3) with A. H. Gibbings and F. Chauntler, and to carry on in the United Kingdom and elsewhere the business of suppliers of electric light and power, electricians, electric and mechanical engineers and manufacturers, manufacturers of electrical and other apparatus and plant, &c. The first subscribers (each with one share) are:—C. P. Titherley, The Limes, Wallasey, Cheshire, electrical contractor; C. P. L. Titherley, Poulton Villa, Liscard, Cheshire, electrical contractor; A. H. Gibbings, Egerton Park, Rock Ferry, Cheshire, electrical engineer; P. Marsh, 42, Hertford Drive, Liscard, Cheshire, solicitor; A. E. Eastwood, 5, Mornington Road, Bolton, solicitor; L. Solomon, 18, Ullet Road, Sefton Park, Liverpool, merchant; and A. J. Branwood, Prieska, Penkett Road, Liscard, Cheshire, broker. Minimum cash subscription 10 per cent. of the shares offered to the public. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification £100. Registered office, Middlehurst Buildings, Manchester Street, Liverpool.

Petropolis Syndicate, Ltd. (90,667).—This company was registered on November 2nd, with a capital of £10,000 in £1 shares, to construct, improve, work and control public works and conveniences in South America or elsewhere, and to carry on the business of tramway, railway, omnibus and van proprietors, carriers of passengers and goods, manufacturers of and dealers in carriages, trucks, locomotives, accumulators, dynamos and other appliances for making, maintaining, equipping and working tramways and railways, &c. The first subscribers (each with one share) are:—H. Fraser, 14, St. Helen's Place, E.C., solicitor; A. E. Bullard, Burleigh, Chudleigh Road, Brockley, S.E., clerk; E. Edwards, 9, Rona Road, Gospel Oak, N.W., clerk; H. P. Dakin, 130, Holmesdale Road, South Norwood, S.E., clerk; R. G. Cheshire, 14, St. Helen's Place, E.C., clerk; R. J. Muggleton, 14, St. Helen's Place, E.C., clerk; and E. C. W. Reffell, 120, Inderwick Road, Hornsey, N., clerk. No initial public issue; the number of directors is not to be less than two or more than six; the subscribers are to appoint the first; no qualification necessary; remuneration as fixed by the company; directors borrowing powers restricted to £20,000. Registered office, 1, London Wall Buildings, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Continental Electricity Co., Ltd. (57,088).—This company's annual return, made up to July 31st, was filed on September 13th. 906 ordinary and 1,000 preference shares have been taken up out of a nominal capital of £20,000 in 1,000 preference and 1,000 ordinary shares of £10 each. £10 per share has been called up on 756 ordinary and 790 preference, resulting in the receipt of £15,460. £3,600 is considered as paid on 244 ordinary and 116 preference. Mortgages and charges: nil.

South Metropolitan Electric Tramways and Lighting Co., Ltd. (61,593).—This company's annual return, made up to June 7th, was filed on September 6th; 14,630 £10 ordinary, 1,957 £10 preference, 159,000 £1 preference shares have been taken up out of a nominal capital of £400,000 in 2,500 preference and 17,500 ordinary shares of £10 each, and 175,000 preference and 25,000 ordinary shares of £1 each; £10 per share has been called up on 1,957 £10 preference and 14,630 £10 ordinary, and £1 per share on 150,000 £1 preference, resulting in the receipt of £185,830; £130,040 remains in arrears. Mortgages and charges: £150,000.

Cascade (1906) Power Co., Ltd. (89,964).—A trust deed dated September 21st, 1906, to secure £75,000 debenture stock, has been registered. Property charged:—First mortgage bonds for £100,000 and 49,995 fully paid $10 shares in the Cascade Water Power and Light Co., Ltd. (incorporated in B.C.). Trustees: West Australian Gold Fields, Ltd., 89 and 90, Cheapside, E.C.

D.P. Battery Co., Ltd. (London) (44,084).—A memorandum of satisfaction to the extent of £750 of first debentures dated October 29th, 1901, securing £10,000, has been filed.

Reason Manufacturing Co., Ltd. (electrical engineers, Brighton), (64,701).—A trust deed dated October 1st, to secure £12,500 second debentures created by resolution of September 25th, 1906, has been registered. Property charged: Certain freehold land and premises in Lewis Road, Preston, Brighton, and the company's undertaking and other assets, present and future, subject to £25,000 first mortgage debentures. Trustees: A. E. Wake, Norfolk House, Laurence Pountney Hill, E.C.

Maxim Electrical Co., Ltd. (London)—(84,426).—Issue on October 8th of £1,100 5 per cent. debentures, part of series created May 16th, 1906, to secure £10,000, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £6,500.

Cowper-Coles Inventions Development Co., Ltd.—Issue on September 20th of £120 6 per cent. debentures, part of series created by resolutions of June 1st and July 4th, 1906, to secure £1,000 debentures, charged on the company's undertaking and property, present and future, including uncalled capital. No trustees. Previously issued of same series, £70.

Dewsbury Electric Manufacturing Co., Ltd. (85,100).—£100 second mortgage "B" debentures, created October 11th and dated October 12th, 1906, charged on the company's undertaking and property, present and future, including uncalled capital (if any) subject to first mortgage debentures, have been registered. Holders: J. Bentley, 11, Grange Road, Horton, Bradford; J. Garsforth, Riddings, Addingham, near Leeds; and H. Brayshaw, Mill Bridge, Liversedge, Yorks.

Vaughan & Son, Ltd. (61,526).—This company's annual return was filed on October 19th, when 3,635 preference, and 20,689 ordinary shares had been taken up out of a nominal capital of £50,000 in £1 shares (20,000 preference and 30,000 ordinary). £24,324 has been received. Mortgages and charges: £5,000.

W. H. Allen, Son & Co., Ltd. (66,440).—This company's annual return was filed on September 8th, when 151,400 shares had been taken up out of a nominal capital of £200,000 in £1 shares. £1 per share has been called up on 1,400, resulting in the receipt of £1,400. £150,000 is considered as paid on the remainder. Mortgages and charges: £53,000.

Fife Electric Power Co., Ltd. (75,736).—A memorandum of satisfaction in full of a trust deed dated August 15th, 1905, securing £15,000, has been filed.

Direct West India Cable Co., Ltd. (53,956).—This company's annual return was filed on October 11th, when 12,000 shares had been taken up out of a nominal capital of £120,000 in 24,000 shares of £5 each. £2 10s. per share has been called up, resulting in the receipt of £30,000. Mortgages and charges: £65,500.

Ernest Scott & Mountain, Ltd. (32,760).—This company's annual return was filed on October 20th, when 97,790 ordinary and 29,800 preferred ordinary shares had been taken up out of a nominal capital of £150,000 in £1 shares (50,000 preferred ordinary). £1 per share has been called up on 75,790 ordinary and 29,800 preferred ordinary, resulting in the receipt of £105,590, in addition to £4 10s. paid on one forfeited share. £22,000 is considered as paid on 22,000 ordinary. Mortgages and charges: £39,600.

Yale Electric Power Co., Ltd. (60,493).—This company's annual return was filed on October 13th, when 668 shares had been taken up out of a nominal capital of £20,000 in 800 shares of £25 each. £25 per share has been called up on 600, and £14,965 has been received, leaving £35 in arrears. £1,700 is considered as paid on 68. Mortgages and charges: Nil.

Simplified Underground Conductor Co., Ltd. (Liverpool), (76,311).—A memorandum of satisfaction to the extent of £1,000 of debentures dated August 28th, 1905, securing £1,500, has been filed.

Dick, Kerr & Co., Ltd. (63,407).—This company's annual return was filed on October 20th, when 305,000 preference and 260,000 ordinary shares had been taken up out of a nominal capital of £650,000 in 350,000 preference and 300,000 ordinary shares of £1 each. £1 per share has been called up on 265,000 preference, resulting in the receipt of £265,000. £300,000 is considered as paid on 40,000 preference, and 260,000 ordinary. Mortgages and charges: £282,580.

Coatbridge and Airdrie Electric Supply Co., Ltd. (89,178).—This company's annual statutory report was filed on September 27th, when seven shares had been taken up out of a nominal capital of £30,000 in 3,000 shares of £10 each. No calls have been made. No mortgages or charges registered.

British Electric Traction Co., Ltd. (49,855).—This company's annual return was filed on September 14th, when 133,301 ordinary and 161,437 preference had been taken up out of a nominal capital of £4,000,000 in 200,000 ordinary and 200,000 preference shares of £10 each. £10 per share has been called up on 117,926 ordinary and 142,500 preference, resulting in the receipt of £2,604,260. £343,120 is considered as paid on 15,375 ordinary and 18,937 preference. Mortgages and charges, £2,002,589.

W. T. Glover & Co., Ltd., cable manufacturers, Manchester (56,124).—A trust deed dated September 29, 1906, to secure £100,000 second debenture stock, has been registered. Property charged: The freehold and leasehold property at Stretford and Salford, Lancs., the company's undertaking and property, present and future, including uncalled capital subject to £100,000 first mortgage debenture stock. Trustees: J. Harwood, Woodsleigh, Bolton; and A. L. Ormrod, 10, Half Moon Street, Manchester.

Newton's, Ltd. (48,936).—This company's annual return made up to October 18th, has been filed; 3,265 shares have been taken up out of a nominal capital of £40,000 in 4,000 shares of £10 each; £10 per share has been called up on 1,865, and £18,650 has been received; £14,000 is considered as paid on 1,400 shares. Mortgages and charges: £10,000.

Halifax and Bermudas Cable Co., Ltd. (28,972).—This company's annual return was filed on October 11th, when the entire capital of £50,000 in £5 shares had been taken up and paid for in full. Mortgages and charges: £37,900.

Frinton-on-Sea and District Electric Light and Power Co., Ltd. (73,689).—Issue on October 4th of £1,500 5 per cent. debentures, part of series created October 26th, 1905, to secure £3,000, charged on the company's undertaking and property, present and future, including uncalled capital, subject to £3,000 first mortgage debentures. Holders: W. Webster and Miss A. A. Mackay, 50, Lee Park, Blackheath, S.E. No trustees. Previously issued of same series: £1,100.

Mexico Electric Tramways, Ltd. (56,932).—This company's annual return was filed on June 14th, when the entire capital of £1,000,000 in 500,000 ordinary, and 500,000 preference shares of £1 each had been taken up. £500,000 has been paid on the preference, and £500,000 is considered as paid on the ordinary. Mortgages and charges: £687,000. Lists dated June 13th and August 13th show that the following directors have recently "retired by disqualification":—Lionel Phillips (alternate), Sir Charles Euan-Smith, Sir Albert H. Markham, L. Wagner (alternate), L. Breitmeyer and J. R. Taylor.

London Electrical Fittings Co., Ltd. (62,468).—This company's annual return was filed on August 30th, when 2,999 shares had been taken up out of a nominal capital of £3,000 in £1 shares. £1,299 has been received, and £1,700 is considered as paid. Mortgages and charges: Nil.

Mather & Platt, Ltd. (60,387).—This company's annual return was filed on October 6th, when 40,000 preference and 40,000 ordinary shares had been taken up out of a nominal capital of £1,000,000 in 50,000 preference and 50,000 ordinary shares of £10 each. £10 per share has been called up on 29,200 preference and 2,500 ordinary, and £317,000 has been received. £183,000 is considered as paid on £10,800 preference and 37,500 ordinary. Mortgages and charges: Nil.

Brentford Electric Supply Co, Ltd. (81,399).—This company's annual return, made up to January 14th, was filed on September 24th 7 shares have been taken up out of a nominal capital of £1,000 in £1 shares No calls have been made. Mortgages and charges: Nil.

Brockie-Pell Arc Lamp, Ltd. (London) (66,602).—£3,000 6 per cent. debentures (3 of £1,000 each) created 9th and dated October 16th, 1906, charged on the company's undertaking and property, present and future, including uncalled and unpaid capital, have been registered. No trustees.

Scottish House-to-House Electricity Co., Ltd. (29,232).—A charge on the company's undertaking and property, present and future, including uncalled capital and Coatbridge and Airdrie undertakings, dated October 17th, 1906, to secure an additional £1,200, has been registered. Holders: County of London Electric Supply Co., Ltd., Moorgate Court, E.C. This charge is endorsed on a deed of charge dated March 31st, 1904.

CITY NOTES.

Burgess Hill Electric Supply Co., Ltd.

THIS company held a peculiar gathering on the afternoon of the 1st inst. It was called the first annual general meeting, but no report or account was or is permitted to be published in the Press, "according to the articles of association." Shareholders themselves are not allowed to have such documents, for one shareholder who had the daring effrontery to move the adjournment of the meeting until printed copies of the report and accounts were received was promptly ruled out of order. Naturally, therefore, when the chairman moved that the report be adopted, the voting went against him (by 10 votes to 7). Shareholders managed to elicit from the chairman that there was every reason for the delay in connection with the accounts, the present secretary having stated that he "found there were no accounts made up at all." For an account of all else that happened at this strange meeting we must refer our readers to the *Sussex Daily News* for November 2nd. From that report we judge that there has never been another meeting like it held in connection with electricity supply business. The end of the proceedings was the appointment of a committee of inquiry, and the chairman indicated that the directors would gladly give this committee their utmost assistance to "have things once and for all absolutely cleared up."

Norwich Electric Tramways Co., Ltd.

The directors' report for the year ended June 30th states that the balance of profit derived from the working of the tramways, as shown by the revenue account for the year, was £9,851; to this sum had to be added £163, interest and transfer fees received, bringing the gross profit for the year up to £10,014. Taking into account the sum of £598 brought forward from the previous year's accounts, the balance to the credit of profit and loss account amounted to £10,613. Deducting from this amount the sum of £2,640, 4 per cent. interest on the company's mortgage bonds for the year, left a sum of £7,978 to be dealt with. The directors recommended that, out of the above sum, £1,000 be placed to reserve fund account; that a dividend of 2½ per cent., amounting to £6,600, be paid on the shares of the company for the year ended June 30th, 1906, and that the balance of £373 be carried forward. Comparing the accounts with those for the year ended June 30th, 1905, the revenue had decreased by £580, and the expenses showed a decrease of £366. Thus there was a decrease in the profits of £214. It must be taken into account, however, that the directors had pursued the policy of making considerable outlays on maintenance and repairs of permanent way and rolling stock, which were both in efficient condition, as well as the power station. The average cost per car-mile was 5·40d., as against 5·30d. in 1904-5. The average receipts per car-mile were 7·67d., against 7·76d. in 1904-5. The number of passengers carried was 7,301,153, a decrease of 107,973 on the previous year, and the number of car-miles run was 1,085,055, as against 1,083,055.

The annual meeting was held in London on October 30th, the Hon. A. G. Brand presiding. It was stated that since the accounts were closed, there had been an all-round improvement, the returns increasing every week.

British Columbia Electric Railway Co., Ltd.

Mr. R. M. Horne-Payne, chairman, presided on Tuesday at the Liverpool Street Hotel over the tenth ordinary meeting of the above company.

In moving the adoption of the report (see Electrical Review, November 2nd), the Chairman said the only point which he thought required any elucidation whatever was the note in the auditors' report as to the treatment of two items of profit. Shortly, what had occurred was this: They found that, by a clerical error, certain charges which should have been made against capital expenditure for the past two years had been made against working expenses, and the management, having ascertained the amount in consultation with the managing director, had now made the charge to the proper account. These items were charged for engineering and supervision on extensions of the system and on new construction generally. In other words, they had for the past two years been making a little more profit than they were aware of. Not wishing to bring this accumulated profit into this year's income, and under the special circumstances the directors not wishing to take their percentage on it, they had taken the opportunity of providing for certain electric lighting machinery and meters which had become obsolete through the advance of science, but which they would, in the ordinary course, have provided for over two or three years. A small remaining sum they had applied to certain exceptional bridge expenditure. They had also this year provided an additional sum for renewals maintenance in order to adjust that account to meet certain items which actual experience showed had not been sufficiently provided for in the past. Proceeding to deal with the prospects of Canada, the chairman said that it was 10 years almost to a day since he had the privilege of signing for himself and his associates a contract under which they acquired the old electric railways of Vancouver, Westminster and Victoria by which he made himself and his firm responsible for the introduction of £70,000 of British capital. On his return home he and his co-director, Mr. Sperling, were very severely criticised for their rashness and hot-headedness in committing themselves to such a vast outlay in an almost unknown and unheard-of land, and many were the prophecies that they would lead themselves and their firm into serious trouble. However, they had faith in the country, and they introduced not £70,000, but approximately £1,500,000, and they had the audacity to ask the shareholders that day to put more money into the country. The country possessed coal and iron deposits, magnificent forests and unlimited water power, and the prosperity of British Columbia, in their opinion, had not yet started. It would really commence when it began to attract capital from the old world, and for this reason the people in British Columbia would do well to think twice before taking part in senseless movements antagonistic to capital. At present it could not be denied that the country had a reputation in the City of London of acting towards capital as the child in the fable did towards the dog, but they who were closely associated with the country knew that the people were as honest as any community, and that day they had a balance-sheet showing remarkable prosperity after 10 years of steady progress. The two difficulties the country had to contend with were shortage of capital and shortage of labour. At present there was nothing like a speculative boom, but in the last few weeks there were signs that the prospectuses of some dozen or so enterprises would be launched. So far, the Canadian market had been clean and honest, but these enterprises were being engineered by American promoters who had so frequently robbed the public. He advised them to be most careful, and to see that the names on the prospectuses were those of reputable Canadian men, and to remember that a political position did not mean a financial and commercial position.

Mr. G. P. Norton seconded the motion, and it was carried.

The Chairman moved a resolution to the effect that the capital of the company be increased to £1,500,000 by the creation of 500,000 new shares of £1 each.

Replying to a question, the Chairman said he did not anticipate that the new capital would be issued within the next six months, but he did not, of course, bind the board in case a good opportunity of using the money occurred.

Mr. Norton seconded the motion, which was carried.

Votes of thanks to the staff and to the Chairman and directors were also agreed to.

Stock Exchange Notices. — The Committee has (1) appointed a special settling day as under:—

Wednesday, November 21st.—South Metropolitan Electric Tramways and Lighting Co., Ltd.—£150,000 4 per cent. debenture stock; and provisional certificates, fully and partly (10s.) paid, for 150,000 6 per cent. cumulative preference shares of £1 each, Nos. 19,571 to 169,570.

And ordered the undermentioned to be quoted in the Official List:—

Babcock & Wilcox, Ltd.—Further issue of 30,000 ordinary shares of £1 each, fully paid, Nos. 800,001 to 830,000.

Great Northern, Piccadilly, and Brompton Railway Co.—£67,000 4 per cent. perpetual debenture stock.

Hadfield's Steel Foundry Co., Ltd.—Further issue of 10,000 4½ per cent. cumulative preference shares of £10 each, fully paid, Nos. 20,001 to 30,000.

South Metropolitan Electric Tramways and Lighting Co., Ltd.—£150,000 4 per cent. debenture stock; and provisional certificates, 10s. paid, for 150,000 6 per cent. cumulative preference shares of £1 each, Nos. 19,571 to 169,570.

Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to:—

Mexican Electric Light Co., Ltd.—$6,000,000 5 per cent. first mortgage gold bonds, Nos. C 1 to C 1,000 for $100 each, D 1 to D 3,000 for $500 each, and M 1 to M 4,400 of $1,000 each. (Special application.)

Mexican Light and Power Co., Ltd.—$13,650,000 capital stock in shares of $100 each; and $12,000,000 5 per cent. first mortgage gold bonds, Nos. 1 to 4,000 for $500, and 4,001 to 14,000 of $1,000 each. (Special application.)

And to allow the following securities to be quoted in the Official List:—

Kalgoorlie Electric Tramways, Ltd.—250,000 ordinary shares of £1 each, fully paid. (Special application.)

Liberian Rubber Corporation, Ltd.—Shares of £1 each, fully paid. (Special application.)

National Electric Construction Co., Ltd.—170,000 shares of £1 each, fully paid. (Renewed special application.)

Compagnie Française des Câbles Télégraphiques.—Our attention has been drawn to the paragraph which appeared in this column on September 21st respecting the Compagnie Française des Câbles Télégraphiques, and which seems to be slightly inaccurate. On reference to the accounts of the French company, which a German correspondent has placed at our disposal, we find that in 1904 the company's receipts were 5,518,964 fr., which sum was increased to 6,318,964 fr. by claiming the whole of the French Government subsidy of 800,000 fr. The total expenses amounted to 6,850,736 fr., thus leaving a debit balance of 531,772 fr. to be carried forward. The accounts for the following year of 1905 show total receipts of 6,799,830 fr. as compared with expenses which reached 7,268,364 fr. inclusive of the debit balance from 1904. It will, therefore, be seen that the subtraction of the former from the latter leaves, as the report itself states, a debit balance of 468,534 fr. on December 31st, 1905 to be carried to the following year.

Rubber Plantations, Ltd.—At the meeting of this company held in London last week, Mr. R. Hoffman, who presided, said that for the first five years previous to the formation of the company only a comparatively small amount of rubber was planted. Since then 80,000 trees had been planted, and the number had now been brought up to 148,000, or, reckoning 200 trees to the acre, there were 740 acres now fully planted under rubber. It was anticipated that, as a result of planting vigorously, the company would have about 240,000 trees at the close of the current year. Mr. T. W. Wellsted, who seconded, said that he had given a great deal of consideration to the question of over-production, and he thought there need be no apprehension. The world's requirements at the present time were 60,000 tons of rubber per annum, and during the last 10 or 15 years the annual increase had been at the rate of 8 per cent. per annum. He thought the world's requirements would double every 10 years, and that they would, perhaps, grow at an even greater rate in view of the large extension of the rubber-using industries.

Eastern Extension Telegraph Co., Ltd.—The report for the half-year ended June 30th, 1906, states that the gross receipts have amounted to £303,791, against £348,849 for the corresponding half-year of 1905. The working expenses, including £22,736 for maintenance of cables, have absorbed £141,246, against £135,950 for the corresponding period of 1905, leaving a balance of £162,545. After deducting income-tax and debenture interest, £142,894 remains as the net profit for the period. After adding £21,064 brought forward there is an available balance of £163,958. Two quarterly interim dividends of 1¼ per cent. each have been paid for the half-year, leaving £88,958 to be carried forward.

Alldays and Onions' Pneumatic Engineering Co.—The directors recommend a dividend at the rate of 5 per cent. on the ordinary shares, together with a bonus of 2½ per cent., leaving £7,147 to carry forward.

Castner-Kellner Alkali Co.—A dividend at the rate of 7 per cent. per annum has been declared for the six months ended September 30th last.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	*	No. of wks.	Total to date. £	*	Route miles open.	*
Aberdeen	Oct. 31	2,459	— 14	22	34,707	+ 1,907	14·4	..
Ayr	„ 27	390	+ 16	24	9,280	+ 77	8	..
Bath	„ 31	1,480	+ 195	44	56,974	+ 6,607	13	..
Belfast	Nov. 2	6,658	+1,969	44	145,827	+45,830	40	+ 6½
Birkenhead	„ 4	1,990	+ 57	31	33,782	+ 805	13·52	..
Blackburn	Oct. 31	1,928	+ 116	31½	33,742	+ 2,148	14·5	..
Blackpool Corp.	Nov. 1	861	+ 117	29	46,355	+ 3,439	11·87	..
„ —Fleetw'd	„ 3	522	+ 32	18	22,450	+ 3,590	8·25	..
† „ —Lytham	Sep. 2	825	+ 155	39	12,897	+ 1,353	7½	..
Bolton	Nov. 4	4,075	+ 446	31	67,679	+ 5,447	26	+ 1
Bournemouth	Oct. 31	2,900	+ 223	30½	55,759	+10,630	21·5	+ 1¾
Bradford	Nov. 3	8,435	+ 309	31	144,977	+ 6,021	53	+ ·7
Brighton	„ 4	1,600	+ 14	31	33,691	..	9·5	..
Bristol	„ 2	9,781	+ 573	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	Oct. 26	446	+ 32	43	9,591	+ 770	3·65	..
Barnsley	„ 26	319	+ 12	„	7,015	+ 108	..	..
Barrow	„ 26	466	+ 58	„	11,358	+ 846	5·37	..
Cavehill	„ 26	114	+ 51	„	4,001	+ 1,799	..	..
Devonport	„ 26	922	+ 84	„	20,0·9	+ 19	8·85	..
Gateshead	„ 26	1,965	+ 116	„	41,899	+ 2,331	11·25	..
Gravesend, N'fleet	„ 26	462	+ 61	„	10,629	+ 547	6·5	..
Greenock	„ 26	1,109	— 125	„	29,226	+ 1,281	7·25	..
Hartlepool	„ 26	549	+ 67	„	13,184	+ 1,617	6·72	..
Kidderminster	„ 26	198	+ 7	„	5,103	— 35	..	..
Leamington	„ 26	347	+ 28	„	7,694	+ 2,676	3	..
Merthyr	„ 26	418	+ 62	„	8,560	+ 357	2·9	..
‡Metropolitan	„ 26	7,028	+1,769	„	149,316	+34,224	22	..
Middleton	„ 26	625	+ 38	„	15,448	+ 682	8·5	..
Mid. Joint Com'tee	„ 26	19,325	— 250	„	435,971	+16,215	..	..
Oldham — Ashton	„ 26	1,162	+ 55	„	24,766	+ 738	9·13	..
Peterborough	„ 26	221	+ 24	„	5,743	— 240	5·81	..
Potteries	„ 26	3,876	+ 331	„	77,032	+ 3,957	29	..
Rothesay	„ 26	105	+ 6	„	10,636	+ 1,601	2·75	..
Southport	„ 26	519	+ 51	„	14,315	+ 508	8·17	..
S. Metropolitan	„ 26	865	..	37	12,625	..	..	..
Swansea	„ 26	1,682	+ 195	43	36,436	+ 5,448	5·5	..
Tynemouth	„ 26	339	+ 36	„	11,616	+ 104	3·75	..
Weston-s-Mare	„ 24	110	+ 22	„	7,217	+ 605	3	..
‡Worcester	„ 26	536	+ 39	„	12,508	— 779	5·75	..
Wrexham	„ 26	206	+ 23	„	4,544	+ 155	..	..
Yorks. Wool. Dist.	„ 26	1,869	+ 570	„	39,271	+11,191	17	..
Miscellaneous	„ 26	202	— 2	„	4,648	— 308	..	..
Burnley	Nov. 3	2,302	+ 100	43	..	..	7·5	..
Burton-on Trent	„ 4	537	— 19	31	9,631	— 435	10	+ 1·5
Bury	Oct. 28	1,921	..	30	30,567	..	10·5	..
Cardiff	„ 27	3,950	+ 308	30	64,717	+ 756	15·87	..
Carlisle	Nov. 3	356	+ 31	44	8,283	+ 95	..	..
Chatham and Dist.	„ 1	1,417	+ 271	44	30,691	+ 1,400	12·84	+ 3·5
Cork	„ 1	876	+ 57	44	21,482	— 85	9·89	..
Croydon	„ 2	2,728	+ 439	22	34,653	+ 3,310	11·25	+ ·5
†Darlington	Oct. 27	200	— 16	30	6,503	+ 228	4·67	..
Darwen	Nov. 2	499	+ 22	31	8,082	+ 392	4·86	..
Dover	„ 3	435	+ 33	31	8,710	+ 1,177	4·75	+ 1½
Dublin	„ 2	9,391	+ 287	18	99,161	+ 5,562	48·75	+ ·25
Dundee	Oct. 31	2,130	+ 316	22	27,376	+ 5,146	13	+ ·5
East Ham	Nov. 3	1,681	+ 206	31	29,243	+ 2,883	8	+ ¾
Exeter	„ 2	552	+ 119	31	9,655	+ 93	4·75	+ ·5
Glasgow	„ 3	33,958	+3,465	25	382,780	+35,121	83·75	+ 8
†Halifax	Aug. 29	1,760	+ 89	22	38,419	+ 1,044	37	+ 1·5
Hastings	Nov. 1	1,441	..	..	..	..	..	..
Huddersfield	„ 3	2,863	+ 214	31	48,332	+ 4,592	28	..
Hull	„ 3	4,657	+ 377	31	72,366	+ 2,556	13	..
Ilford	„ 3	856	+ 58	31	15,703	+ 802	6·37	..
Ilkeston	Oct. 31	290	+ 44	31	4,395	+ 523	3·5	..
Ipswich	Nov. 3	736	+ 48	31	14,474	+ 47	10·5	..
Isle of Thanet	„ 3	611	+ 47	44	20,580	+ 987	11	..
Kilmarnock	„ 3	307	+ 29	25	4,065	+ 86	4·25	..
Kirkcaldy	Oct. 31	541	+ 161	..	..	..	7·5	..
Lan'kshire Trm. Co.	Nov. 1	1,911	+ 126	44	39,087	+ 6,291	12·56	+ ½
Leeds	Oct. 27	12,416	+1,335	30	192,774	+12,064	96	+ 6·5
Leicester	Nov. 3	4,172	+ 268	44	..	..	..	..
Leith	Oct. 27	997	+ 276	24	12,877	+ 5,305	6	+ 1
†Liverpool	„ 20	10,978	+ 867	42	454,737	+ 9,916	104	+ 1
‡L.C.C.	„ 20	53,427	..	29	768,057	..	166¼	+ 55¼
London United	Nov. 2	11,886	+1,979	44	277,099	+22,694	..	..
Lowestoft	„ 3	373	+ 57	5	974	+ 142	3·5	..
Manchester	„ 3	27,765	+2,699	31	435,849	+32,864	146	+21
†Newcastle	Oct. 27	3,984	+ 165	30	123,563	+ 8,026	25·5	..
Newport	Nov. 3	1,235	+ 156	31	20,288	+ 1,528	14·5	+ 1·5
Northampton	„ 2	787	+ 77	31	14,362	+ 427	5·5	..
Oldham	„ 4	3,558	+ 360	32	59,044	+ 5,945	38·75	..
Pontypridd	„ 3	317	+ 33	31	5,304	+ 204	3·5	..
Portsmouth	„ 3	3,218	+ 210	31	67,761	+ 483	14·5	..
Preston	Oct. 31	1,412	+ 237	..	..	..	10	..
Reading	Nov. 1	1,193	+ 68	31	20,347	+ 292	7·5	..
Rochdale	„ 3	1,953	+ 384	30	33,660	+ 9,129	20·6	..
Rotherham	„ 1	999	+ 108	31	15,715	+ 1,488	10	+ ·66
Salford	Oct. 29	8,859	+ 792	30	138,985	+ 5,143	38·9	..
Sheffield	Nov. 4	10,286	+ 861	32	170,681	+12,051	55·75	+ 1½
Southampton	Oct. 31	1,804	+ 63	30½	31,298	+ 501	..	..
Southend-on-Sea	„ 31	583	+ 67	31	14,205	+ 878	6	..
Stockport	..	..	..	..	..	..	..	..
Sunderland	Nov. 4	2,576	+ 163	31	45,174	+ 2,738	10·87	..
Tyneside	Oct. 31	815	— 85	44	20,243	+ 1,826	8·87	..
Walthamstow	Nov. 3	998	+ 236	31	19,805	..	10	..
West Ham	„ 1	4,390	+ 646	£1	71,839	+15,902	14·7	+ 1·4
Wolverhampton	Oct. 31	1,645	+ 132	31	26,849	+ 1,301	12·5	..
Yorks. W. Riding	Nov. 4	1,810	+ 322	44	36,575	..	..	..
Baker St.-Waterloo	„ 3	3,705	..	18	26,616	..	3·75	..
Cen. London Rly.	„ 3	13,100	— 863	18	104,608	— 5,043	6	..
City & S. Lon. Rly.	„ 4	5,740	— 26	18	46,589	+ 2,199	6·25	..
Dublin-Lucan Rly.	„ 2	200	+ 7	18	2,417	— 28	7	..
G. N. and City Rly.	„ 3	3,730	+ 217	18	29,733	+ 2,060	3·5	..
L'pool Overh'd Rly.	„ 4	2,795	+ 26	18	27,199	— 474	6·8	..
Mersey Railway	„ 3	3,537	+ 281	18	30,184	+ 2,320	4·5	..
Metropolitan Rly.	„ 4	31,015	..	18	264,808	..	70·5	..
Met. District Rly.	„ 4	16,253	+1,082	18	135,241	+11,212	24	..
Anglo-Argentine	„ 4	33,192	+5,814	44	662,660	+77,261	48	..
§Auckland	Oct. 12	9,828	+ 715	40½	99,834	+ 6,748	19·24	+ ·6
§Brisbane	„	11,721	+1,371	..	..	..	..	..
§Brit. Columbia Rly.	Sep.	23,551	+2,967	13	59,223	+ 8,706	..	..
Bu'n's A'r's E.T.Co.	Oct. 6	2,752	+ 195	40	51,216	+ 7,987	24	..
Bu'n's A'r's-Bigr'no	„ 28	7,516	+1,076	43	155,665	+ 7,291	..	..
Calcutta	Nov. 3	6,048	+ 592	..	..	..	..	..
§Cape Electric T. Ld.	Sep.	13,599	..	..	..	..	..	..
§Geneva	„	8,782	+ 852	..	..	..	..	..
§Kalgoorlie, W.A.	„	4,106	..	39	38,998	..	20·5	..
Madras	Oct. 31	997	+ 140	43	19,104	+ 2,257	10·5	+1½
§Lisbon	Sep.	25,945	..	..	..	..	..	..
§Mexico	„	74,400	..	..	..	..	..	..
Perth (W.A.)	Nov. 2	2,851	— 10	44	68 822	+ 3,493	24·25	+ 5

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Afternoon.

Less trade is doing in the Stock Exchange than was the case last week. Nobody seems at all clear that the Bank Rate will be retained at 6 per cent.: an advance to 7 per cent. would occasion more flatness than astonishment. Moreover, the current Stock Exchange account is one of those which run for 19 days, and the sentimental dislike to these protracted settlements does help to check business, however difficult it may be to explain the reason why.

By the lamented death of Mr. George Herring, a loyal supporter is lost to Charity and to the electrical markets. He was, of course, chairman of the City of London Electric Lighting and the Electric and General Investment Companies, but his intimate connections with the company world went into many other concerns. Mr. Herring had close associations with the British Electric Traction Company, and the group around it. He was interested in the Westinghouse Company, the Brush Electric, London United Tramways, and County of London Electric Lights and others. And when Mr. Herring took up a thing, he backed his opinion with no lack of courage. Many is the time that the market in his own particular shares would have come to the verge of collapse had not he rendered the necessary measure of support to steady prices. It is in this direction that the Stock Exchange will—speaking in a merely business manner—feel the loss of Mr. Herring more than in any other.

Electric lighting shares were naturally depressed at the news of his death. Citys and Counties both gave way. But they recovered again upon the result of the Borough Council elections. The defeat of the Progressives has caused talk of a possible sequel at the County Council elections next spring, and as the electrical lighting market has little to gain, at present, from the hands of municipal trading, the prospect of a Moderate majority at Spring Gardens brought about a rally in prices. Chelsea shares at 5⅜, and South Londons at 3 are ⅛ up. Westminster Ordinary rose ¼ to 9¾, Metropolitans and St. James's a like fraction to 8¼ and 10 respectively. South Metropolitan Electric Lighting Ordinary are $\frac{1}{16}$ down at 12s. 6d. In the provincial list, Oxfords advanced to 6⅜. Confidence is said to be returning, and the domestic political situation has neutralised the unfortunate effect which the death of Mr. Herring exerted over prices.

Considerable excitement has attended the spurt of some two points in the price of Anglo "A." Two powerful firms of Stock Exchange jobbers took the stock in hand and hoisted the quotation with an ease that appeared to reflect a scarcity of floating supply. The ostensible explanation for the rise is that the Anglo-American Telegraph Co. has been doing phenomenally well of late, and that a dividend of 30s. on the Deferred stock next January is almost assured. There may be much virtue in that "almost." The Ordinary stock at 66½ is a point better.

Several other rises have also to be noticed. Western Telegraphs at 14¼ and West Africans at 10¼ are 5s. better. Great Northern of Copenhagen rose 30s. to 37½ upon a small demand in a narrow market. Eastern Telegraph Preference put on ½, but the Ordinary stock lost an equal fraction, leaving a holder of both securities all square.

Telephone descriptions are without motion.

British Electric Tractions slumped again to 3½ as a direct consequence of Mr. Herring's decease, but afterwards rallied to 3¾. The price of the Preference is down ¼ to 7⅞, while the second Debenture stock has fallen to 88½. Brush Second Debenture, somewhat curiously, is better at 84½. Westinghouse Preference dropped to 77, and very nominal at that, the shares keeping them company by falling to 25s. Amongst electric railway stocks, Metropolitan Consolidated is 60, unaffected by the delay in the long-awaited electrification between Hammersmith and the East End, which, at the early part of the week, had not fulfilled expectation by being opened. District Ordinary rose to 21, no doubt because the *Pall Mall Gazette* had a good word or two the other day for a company whose finances have for long been the subject of our militant contemporary's severest flagellation. Charing Cross, Euston and Hampstead Debenture is about 85; Great Northern, Piccadilly and Strand Debenture about a point higher, while the Bakerloo Debenture remains at 91½.

The Castner-Kellner Alkali Company has advanced its dividend to 7 per cent., but the price is still 22s. Henley's Telegraph Debenture improved to 109, and other Manufacturing issues call for no comment.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Oct. 30th.	Closing Quotations Nov. 6th.	Business done week ended Nov. 6th, 1906. Highest	Lowest.	Rise + or Fall —
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3⅜ — 4½	3⅜ — 4½	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	5 %	84 — 93	88 — 93	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	23⅝	31⅛	64½ — 66½	65¼ — 67½	..	..	+ 1
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5⅛	6 %	109½ —110½	109½ —110½	110¾	109½	..
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	⅛	23⅜ — 23⅝	25⅛ — 25⅞	25⅞	25⅛	+2⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	101 —103	101 —103	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	8 %	6¾ — 7¼	6¾ — 7¼	..	..	..
1,992,856£	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	98	97½	..
16,000	Cuba Telegraph	10	6¼%	10 %	5 %	5 %	8¼ — 9 xd	8¼ — 9 xd	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 — 18 xd	17 — 18 xd	..	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	8⅜ — 8¾	8⅜ — 8¾	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8⅞ — 9⅜	8⅞ — 9⅜	..	..	..
80,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	99½ —102½	99½ —102½	..	..	..
60,710£	Direct United States Cable	20	3½%	3 %	3½%	4½%	15½ — 16	15½ — 16	15½	15⅜	..
65,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,300, R.	100	4½%	4½%	4½%	4½%	100½ —102½	100½ —102½	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	7 %	140½ —143½	140 —143	142½	140½	— ½
2,000,000	Do. 8½ % Pref. Stock	100	8½%	8½%	8½%	8½%	89½ — 91½	90 — 92	91½	90½	+ ½
1,848,772	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 %	107 —109	107 —109	107½	..	..
800,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	13½ — 14	13½ — 14	14	13½	..
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	105½ —107½	105½ —107½	..	..	..
800,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	99 —101	99 —101	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius S ⊃ b.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 —103	99 —101 xd	..	..	..
180,887	Globe Telegraph and Trust	10	£8	5½%	5⅝%	5½%	10½ — 11 xd	10⅛ — 10⅝ xd	10⅜	10⅛	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14½ — 14⅝ xd	14⅞ — 14¼ xd	14⅝	14½	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	24%	35 — 37	36 — 38	36½	..	+1
37,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,300, Red.	100	4½%	4½%	4½%	4½%	100¾ —102½	100¾ —102½	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	18 %	13 %	58½ — 60½ xd	58½ — 60½ xd	59	..	..
251,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	Nil	1 — 1⅛	1 — 1⅛	..	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	5 %	1 1/16 — 1 1/8 xd	1 1/16 — 1 1/8 xd	..	..	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	⅞ — 1 xd	⅞ — 1 xd	..	..	..
1,988,338	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108½ —110½	108 —110	109½	108½	— ½
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	108 —110	108 —110	109½	108	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	11 — 13	11 — 13	12½	11½	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	10½ — 12½	10½ — 12½	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜ — 5⅝	5⅜ — 5⅝	5 5/32	5⅛	..
3,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	98 —100	98 —100	..	..	..
1,999,598	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	101 —103	101 —103	101⅞	101½	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¼%	6¼%	7½%	1½ —1⅝ xd	1½ — 1⅝ xd	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/16	1 1/16 — 1 1/16	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 — 99	97 — 99	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
11,889£	Reuter's	8	5 %	5 %	5 %	5 %	7¼ — 7⅞	7¼ — 7⅞	..	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	101 —104	101 —104	..	..	..
3,301	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 —130	127 —130	129½	127½	..
70,000	United River Plate Telephone	5	7 %	8 %	8 %	8 %	7 — 7⅛	7 — 7⅛	7⅛	7	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¼ — 5½	5¼ — 5½	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	109 —112	110 —113	..	..	+ 1
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½%	4 %	9⅜ — 10⅜	10 — 10⅛	10⅜	..	— ½
80,008	W. Coast of America, 1 to 80,000 & 88,001 to 88,008	2½	Nil	Nil	Nil	Nil	⅜ — ⅝	⅜ — ⅝	15/-	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Bras. Sub. Tel.	100	4 %	4 %	4 %	4 %	100½ —103½	100½ —103½	..	..	..
307,980	Western Telegraph, Ltd., Nos. 1 to 307,980	10	7 %	7 %	7 %	7 %	13⅜ — 14⅜	14⅛ — 14⅝	14⅝	13⅜	+ ⅜
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	.. ..	.. ..	..	..	..
568,880	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 —105	102 —105	..	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜ — ½	⅜ — ½	..	..	..
84,563	Do. do. 6 % Cum. 1st Pref.	10	7 %*	7 %*	6 %	5 %	7½ — 8	7⅛ — 8	7⅛	..	..
4,869	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	4½ — 5½	4½ — 5½	5¼	5⅛	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	..	..	..

Including arrears.

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, Nos. 260,008 to 510,007, and 560,008 to 580,007	5	..	..	8 %	8 %	7 — 7¼	7 — 7¼	7⅛	7	..
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5 13/16 — 6 1/16	5 13/16 — 6 1/16	5 13/16	5 27/32	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	139 —142	139 —142	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	103 —105	103 —105	105	104½	..
800,000	Babcock & Wilcox, 1 to 800,000	1	..	17 %	20 %	20 %	3⅞ — 4	3⅞ — 4	77/6	..	..
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..
88,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	7 %	7 %	5 1/16 — 5 1/8	5 1/16 — 5 1/8	..	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	7 %	7 %	6¼ — 6⅜ xd	6¼ — 6¼ xd	6⅜	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	6 %	6 %	5¼ — 5⅜	5¼ — 5⅜	..	..	..
90,000	Do. do. 4 % Funding Certs.	5	..	..	4 %	4 %	4 — 4¼	4 — 4¼	..	..	..
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	102 —106 xd	102 —106 xd	102½	102	..
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	..	100 —103	100 —103	102	101	..
500,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	6 %	125 —130	125 —130	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	5 %	110 —115	110 —115	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	108 —111	108 —111	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	102 —105	102 —105	102½	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
188,801	British Electric Traction	10	8 %	6 %	6 %	3 %	3⅞ — 4⅛	3⅛ — 4	75/-	66/3	— ½
161,487	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	7⅞ — 8⅛	7⅞ — 8	7⅞	7 7/8	— ⅛
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	105 —110	105 —109 xd	108	105½	—1
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	92½ — 95½	87 — 90 xd	87½	..	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6¼ — 6⅜	6¼ — 6⅜	6¼	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	94 — 98	94 — 98	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1¼ — 1⅜	1 — 1⅛	..	..	— ⅛
1,016,858	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	77 — 80	75 — 79	75	..	—1½
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	1/6 — 1/9	1/6 — 1/9	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781 ..	2	Nil	Nil	Nil	2½%	¾ — 1	¾ — 1	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	6 %	1⅜ — 1⅝	1⅜ — 1⅝	..	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	96 — 98	96 — 98	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 — 84	83 — 86	..	..	+1½
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	3 %	3 — 3⅛	3 — 3⅛	61/3	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	6 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
27,500	Do "B" do. 1 to 27,500	5	..	6 %	6 %	6 %	4⅜ — 5⅜	4⅛ — 5⅜	97/6	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	105 —107	105 —107	105	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 —105	102 —105	..	..	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	8 %	8 — 8⅛	8 — 8⅛	..	..	..
32,610	Do. 105,001 to 137,610	5	..	..	..	8 %	7⅞ — 8⅛	7⅞ — 8⅛	..	..	..
29,330	Do. 5 % Cum. Pref., Nos. 1 to 29,330	..	..	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	5⅛	..	..
850,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 —106	106	..	..
85,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	15%	10 — 11 xd	10 — 11 xd	10⅛	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
800,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	109½	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 %§	⅜ — ⅝	⅜ — ⅝	12/6	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	6 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	23/9	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	97 —102	97 —102	..	..	..
1,999,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	83 — 85	83 — 85	84½	83½	..
580,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	97 — 99	97 — 99	..	..	..
580,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	73 — 76	73 — 76	..	..	..
1,480,000	City and South London Railway	Stock	3½%	2¾%	2¾%	1⅞%	42 — 44	41 — 43	42⅞	42	—1
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½%	2½%	2½%	1½ — 1⅝	1½ — 1⅝	..	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 — 98	95 — 98	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—(Continued)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(continued).

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Oct. 30th.	Closing Quotations Nov. 6th.	Business done week ended Nov. 6th, 1906. Highest.	Lowest.	Rise or Fall—
260,000	Dick, Kerr & Co., 1 to 260,000	† 1	..	..	10 %	..	1 7/16 — 1 1/2 xd	1 7/16 — 1 1/2	31/6	..	..
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	..	6 %	6 %	6 %	1 1/8 — 1 1/4	1 1/8 — 1 1/4	..	..	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	103 —106	103 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½ %	6 %	6 %	14 — 15	14 — 15	..	..	..
59,987	Do. 6% Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14 — 15	14 — 15	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½ %	4 3/16 %	1½ — 1 3/4	1½ — 1 3/4	..	..	..
17,189	Do. "A" shares, 01—017,189	5	Nil	Nil	2½ %	4 3/16 %	2 1/4 — 2 3/8	2 1/4 — 2 3/8	..	..	..
844,028§	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000§	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	90 — 95	90 — 95	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	Nil	3/16 — 7/16	3/16 — 7/16	..	..	..
81,390	Do. do. 7 % Cum. Pref., 1 to 81,390	2	7 %	7 %	7 %	7 %	1 3/4 — 2 1/4	1 3/4 — 2 1/4	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	83 — 86	83 — 86	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	5 %	9 — 9½	9 — 9½	..	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	91 — 94	91 — 94	..	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3 %	4 %	4 %	3½ — 3¾	3½ — 3¾	73/9	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½ — 10¾	10½ — 10¾	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	101 —102	102 —103	..	..	+1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	12 — 13	12 — 13	12⅜	12¼	..
200,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	4½ %	5¼ — 5¾	5¼ — 5¾	..	..	..
150,000	Do. do. 4½ Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	4½ %	107½—109½	108 —110	..	..	+ ½
60,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10%	5 %	10%	17 — 18	17 — 18	17⅜	17	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	13%	1½%	Nil	1 1/16 — 1 1/8	1½ — 1⅝	..	..	+ ⅛
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	4½ — 6½	4½ — 6½	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	8 %	8 — 8½	8 — 8½	8 1/32	8⅛	+ ⅛
399,930	Do. do. 60,008 to 100,000 (£6 paid)	10	..	8 %	6 %	8 %	3½ — 4½	3½ — 4½	..	..	..
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	8 — 9	8 — 9	..	..	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	90 — 95	90 — 95	..	..	..
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	3 %	3/16 — 5/16	3/16 — 5/16	2/6	..	—1/16
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1 3/16 — 1 5/16	1 3/16 — 1 5/16	17/9	..	..
950,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½ %	4½ %	97 —100	97 —100	..	..	..
150,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 50,000	5	..	..	6 %	6 %	4½ — 5	4½ — 5	..	..	..
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	4 %	6½ — 7½	6½ — 7½	..	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	7½ — 8½	7½ — 8½	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½ %	4½ %	4½ %	101 —104	101 —104	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	32¼ — 34½	32 — 34	32½	..	— ½
150,000§	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
8,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	90 — 92	90 — 92	91¾	91½	..
540,000	Waterloo & City Railway, Ord. Stock	100	3½%	3½%	3½%	3½%	99 —102	99 —102	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8⅓%	3 %	Nil	Nil	⅛ — 1	⅛ — 1	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	Nil	Nil	1½ — 2¼	1⅜ — 2¼	40/-	..	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	75 — 80	75 — 80	..	..	..

ELECTRICITY SUPPLY COMPANIES.

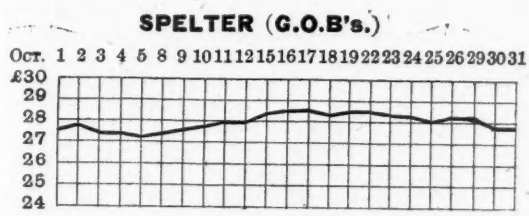
14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5½%	4 ¾%	5 — 5½	5 — 5½	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	99 —101 xd	90 —101 xd	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8¼ — 8¾	8¼ — 8¾	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 1/2 — 8	7½ — 8	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	3½ — 4½	3½ — 4½	..	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4½ — 5	4½ — 5	..	..	..
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4 — 4½	4 — 4½	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —104	101 —104	..	..	..
44,436	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5 — 5½	5⅛ — 5⅜	..	..	+ ⅛
175,000§	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	106 —109	106 —109	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	9½ — 10½	9½ — 10½	9⅜	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 — 12	11 — 12	..	..	..
400,000§	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	125	124½	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	2⅛ — 3 3/16	2⅛ — 3 3/16	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅜	5 — 5⅜	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8¼ — 8⅝	8¼ — 8⅝	..	..	..
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	11¼ — 11⅝	11¼ — 11⅝	..	..	..
400,000§	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	107 —110	107 —110	109	108¾	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	100 —102 xd	100 —102 xd	..	..	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	4 %	3 — 3½	3 — 3¼	63/9	..	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	4¾ — 5¼ xd	4¾ — 5¼ xd	93/6	..	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	100 —103	100 —103	..	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	5½%	5⅝ — 5⅝	5⅝ — 5⅝	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	4⅝ — 5⅛	4⅝ — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	99 —102	99 —102	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	8 — 8½	8 — 8½	..	..	..
10,000	Do. New (£6 10s. paid)	£3	..	8½%	8½%	9 %	7 — 7½	6¾ — 7¼	..	..	— ¼
87,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	99 —101	..	..	..
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	99 —101	99 —101	..	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½	12 %	10 %	9¾ — 10¼	9¾ — 10¼	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	1⅜ — 2⅛	1⅜ — 2⅛	..	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4⅝ — 5⅜	4⅝ — 5⅜	..	..	..
874,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	7⅜ — 8⅛	7⅜ — 8⅛	8 1/16	8	+ ⅛
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅝ — 5⅝	5⅝ — 5⅝	..	..	..
220,000§	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	109 —113	109 —113	..	..	..
250,000§	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	97½	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..
75,000	Newcastle-on-Tyne, 1 to 75,000	5	..	8 %	8 %	8 %	7⅞ — 8	7⅞ — 8	..	..	..
75,000	Do. 5 % Pref., 1 to 75,000	5	..	5%	5 %	5 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½ %	13½ — 14½	13½ — 14½	..	..	..
64,000	Do. do. 4 % 1st Mort.Deb.	100	4 %	4 %	4 %	4 %	96 — 98	96 — 98	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6 — 6½	6⅛ — 6⅝	..	..	+ ⅛
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	98 —100	98 —100	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	9½ — 10½	9⅝ — 10⅜	9⅝	..	+ ⅛
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..
150,000§	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	95 — 97	95 — 97	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	1 — 2	1 — 2	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	73 — 77	73 — 77	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½	8 %	4 %	4 %	2⅜ — 3⅛	2⅜ — 3⅛	58/9	..	+ ⅛
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	Nil	2½%	⅜ — ⅝	5/16 — 7/16	..	..	— 1/16
117,968	Do. Do. 7 % Pref.	1	Nil	7 %	7 %	7 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	26/6	..	..
200,000	Do. Do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	3 — 3½	3 — 3½	..	..	..
80,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	4¼ — 4½	4¼ — 4½	88/9	87/6	..
00,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	97 —100	97 —100	..	..	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	9 — 10	9⅛ — 10⅛	9⅜	9¼	+ ⅛
28,151	Do do. 4½ % Cum. Pref. (Originally 5%—Red. to 4½ % from 31st Dec., 1905.	5	5 %	5 %	5 %	5 %	5¼ — 5⅜	5¼ — 5⅜	5 3/16	..	..

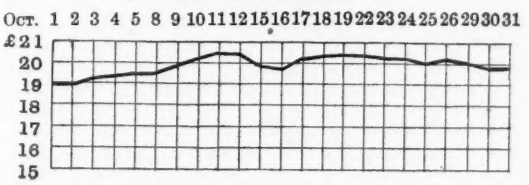
Shares not officially quoted:—Mackay Companies, ord., 74—76. Pref. 72—74.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

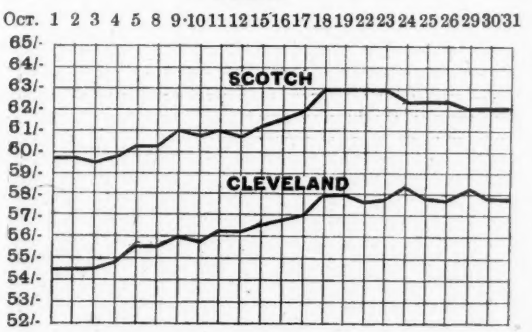
(Bank rate of discount 6 per cent. October 19th. 1906.

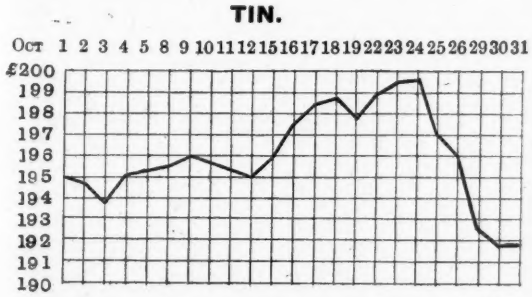
METAL MARKET.

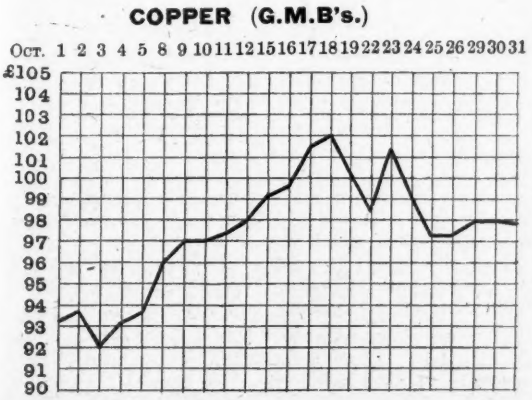
Fluctuations in October.











THE ELECTRICAL FROISSART CHRONICLES.

(With some apologies to Sir John, and more to "F. C. G.")

By IBID.

XI.—Avernus.

Much it is to be deplored that in these days the people hide themselves in holes, caves and dennes of the earth, called basements, and even deeper; so that while the stretes and ways that enjoy the moonshine and presence of the unclouded sky be all full of wains and monstrous loads of merchandise, the middlemen and narrow majorities of the race must travel as best they may in sorry conduits. Moreover, only of these later times doth any regard this subterraneous world, to free it from the vile vapors and sulphurous steams that filled it before; so by good favour of the Electricks, and high-tension magick, is it contrived that the inner circle may travel thereon without that they emerge to the upper world black in the face, and with inwards furred like a tinker's kettle. These things have I not of my own knowledge, but from a writing describing the dangers and delights of a journey in those same regions, by the hardy Ulysses, an explorer of no mean attainments.

The cause of his journey was this: having appointed to meet Eurydice, the wife of his bosom, on his return from the labours of the day at the issue or relief-hole of Nutting Hill Gate, he was suddenly seized with a qualm or premonition that she, being unused to that dismal underway, might by the janitors be supposed to ask rather for an infernal than a vernal destination; to wit, for the gate of some place which is all down hill. And in this fuss and pother (wherein I think he was hardly justified), he was recklessly to Cerberus and demands permission to explore fully those regions. From whom he meets with a courteous reception and full leave; howbeit, a guerdon of 1·5 groats; whereat Ulysses, well assured he had seen granted the same privilege (facilis descensus) for one groat, was for waxing wroth, and to inform the *Times* of this infraction of liberty, but that the time lacked him to do it; moreover, as Time seems to grow less and less daily, none now accord the name the respect and terror of former years; saying "I have no time," or to "do time," surely a disrespectful act.

So was Ulysses fain to give the poor dog his bonus and begone. This larger sop to Cerberus is, by some, held to be from the coming of the Electricks into those regions; yet it is said that, had they not so done, the place had of a surety been closed, to the great lament of all Christendom. Howbeit, if the extra denier is to the Electriks they do well therein; for any that giveth his labour is the more hated, sith they say, he hath sinister motive; but he that is fully paid therefor is well respected; and he that hath large reward for doing nothing is universally admired and beloved.

Now Ulysses was entered into the mighty caverns and resounding depths of that under-world; and, waiting there a space, perceives issue from untold blackness a catafalque or covered vessel riding upon fire of considerable resistance. Thence issuing Charon, with horrid clangour and continuous shouting of "Passe Devant," are thrust aboard the waiting shades, sorted according to their iniquity into divers stages, as "thirds" and "smoking." For the "firsts" (or they that arrive first) have a whole space to themselves, but the rest only a third, or less portion. As for those that are smoking none put them out. Now this system of sorting is well liked of the Englysshe, and is their law, namely: when any "train" stayeth at a stage, the guardians thereof shall blow violently of their whistles, in sign of departure; so that all who are on the stage rush violently up and down, over-turning each other, in search of a seat in their own class or caste; they that have none are the losers in the game. And when all are settled, come the guardians to enforce fine and amerce on those that chose wrongly; howbeit, if any be exceeding besmirched, over-drunk and noisy, he may ride where he listeth. This is their rule aboveground, but below have they little time for such jestes.

So clinging from the masts and cordage (as I suppose) and sore amazed at the furious rocking of that boat begins the amazing journey. Nor is visible any steersman or driver,

but forward can be seen the advancing burrow and winding ways of the place; doubtless is this the "Passe de Devant" aforesaid.

When questioned as to the likeness of the styx, Ulysses saith that it doth not always; but that the system is full of Yerkes. For suddenly, by fierce magick, the vessel ceaseth in its tracks, and thereby are sundry voyagers, flying forward, discharged on the staging hard by; but the places are filled by another flock rushing in, doubtless for that hall is too hot for their good comfort. And Ulysses saith, in sooth ye shall see at one hall lawyers descend; at another merchants; yet again soldiers; in a fourth, scholars; in a fifth artisans; so that it seems that few indeed escape. So I asked him if he had been even to the seventh, or deepest of those divisions, and he, looking at me shrewdly, saith, beyond that, even to Parson's Green. But he assureth me that all is now changed and clean, so that ye may go there without danger, and return when you will; and all that is evil is that it is very full.

Now this I can well believe.

COMPETITION.

By E. E. HOADLEY, M.I.E.E.

The present article owes its inception to the remarks made by the various speakers on the papers read by Mr. Fedden and Mr. Collings Bishop at the last M.E.A. Convention. From what was said by several borough electrical engineers, chiefly but not solely those having charge of undertakings in towns varying from thirty to seventy thousand inhabitants, it was patent that competition, along certain lines and in certain places, with the local gas companies was becoming severe, and that if this competition was to be met successfully, energetic measures would have to be taken.

There is not the slightest cause for alarm: the situation only requires careful analysis, when in the generality of cases the best remedies, often governed by local conditions, will be found. It is true that in many cases, particularly where the electric light undertaking is in the hands of the municipality, and the gas undertaking in the hands of a local company, the former is very much handicapped in several ways. First, there is generally a strong local influence in favour of the gas company, some of the leading business men of the town being on the directorate, and many others, holding shares therein, taking the erroneous view that any support they may give to the electrical undertaking will be at the expense of the gas company, and incidentally of their own pockets; next, and usually of greater importance, particularly where the gas company is of an enterprising nature, is the fact, that under the, in many cases, unfair restrictions applying to a local authority the engineer has to sit still and see business scooped from under his nose simply because the gas company can under their Act or Order offer greater advantages.

The time has now arrived when it behoves all those interested in the supply of electricity, and the development of municipal electrical undertakings, to find out exactly where the difference between the regulations under which a company supplying gas works, and those under which a municipality runs an electricity supply business, is to the disadvantage of the latter, and by every means in their power to get them altered until both work under the same regulations. Then, and only then, will the competition be fair.

It is a long-exploded fallacy that engineers in charge of supply undertakings are a superior race of beings, and that electric light is such a wonderful novelty that the engineer has only to sit in his office and business will come in as fast as or faster than he is able to deal with it. There has been far too much of this in the past, but nowadays an engineer who has the success of his undertaking at heart must recognise the fact that he has something to sell just the same as in any other business, and must by means of constant advertisement, canvassing and every other means in his power go to his prospective consumers, and induce them to "cross the rubicon."

It is not enough to "sell electricity," and to declare that the responsibility of the undertakers ceases at the consumer's terminals. It must be remembered that while the undertakers sell electrical energy, the consumers buy light, heat or power as the case may be, and it surely is the duty of the supply authority to see that the consumer gets the most light, heat or power for the least amount of energy, or, in other words, for the least cost. Unless this is done, it may be taken for granted in a great many towns that even after the consumer has been obtained he will not be a permanent one, but after two or three years he will say that electric light is twice as dear and not so good as gas, and will go back to the latter.

In the town in which the author has been in charge of the electricity supply business for the last five years, the afore-mentioned disadvantages have been very keenly felt.

There is a flourishing and enterprising gas company having large local influence, and a company which recognises that in order to keep old consumers and get new ones the way must be made as smooth and easy as possible. Before the advent of electricity the gas company did practically as they pleased, and beyond supplying the consumer with gas did very little else; after electricity supply was established this was all altered, and strong competition was at once the order of the day. Gas stoves for heating as well as for cooking purposes were fixed free and let out on hire at extremely low rates. Gas engines were sold on the instalment plan and fixed free. Houses and business premises were piped absolutely free of charge either to the landlord or the tenant, and in cases where speculative builders were putting up rows of smaller houses, these were all included, and piped free as they were built; the fittings for these premises were either hired at very low rates, or sold either for net cost or less. Special lamps were designed for lighting the outside of shops; these were fixed free, and let out on hire for ridiculous quarterly rents, the rents including all new mantles, and the cleaning and up-keep of the lamps.

On the top of all this, gas was supplied at the very low rate of 2s. 4d. per thousand for lighting, and 2s. 2d. per thousand for power purposes. The Gas Co. also took on a staff of men who called at every consumer's house or shop to ask if there are any complaints, and who for a small quarterly charge undertook the renewal and upkeep of all incandescent gas mantles.

The effect of all this on the electricity supply business was felt as soon as the novelty of the newly introduced electricity had worn off. Several of the consumers of the latter who had been extremely extravagant in the use of their light, and were frightened by their first two or three bills, immediately went back to gas without giving the supply authority a chance of showing them how to have the convenience of electric light at very little above the cost of gas; people building new houses would not go to the expense of wiring them when they could get them piped for nothing; the speculative builders to whom every pound on a house meant something, and who before this had wired their houses as an inducement to their sale, would not now face the outlay for wiring, but contented themselves by letting the gas company put the pipes in for nothing, and if prospective buyers asked for the house to be wired, informed them that electric light was very much more expensive than gas, and this was the sole reason that the house had not been wired; users of power would not face the outlay for a motor when they could get a gas engine by means of 12 or 20 quarterly payments; many of our consumers told us that they would have to consider very seriously the question of going back to gas as, the gas company now looked after them so much better than the electricity supply authorities, and that when anything went wrong with their gas fittings or any alteration had to be made, they had only to send to the gas company, whereas with electricity if they sent to the supply station they were referred to a wiring contractor.

In the face of all this, something had to be done, and done quickly. The first thing was to get the prices of electrical energy reduced to a figure that would compete favourably with the cost of gas; thanks to an enterprising committee this was done. Then arrangements had to be made to do practically all that was being done by the gas company. This embraced:—

1. A so-called free-wiring scheme.

2. The supply of motors, either on hire or hire-purchase.

3. The wiring of small houses absolutely free of charge to either landlord or tenant.

4. The hiring-out of arc lamps.

5. The inspection of lamps, &c., on consumers' premises at regular intervals.

The details of these arrangements, which have generally been found to work exceedingly well in practice, are as follows :—

Free Wiring.—A scheme was got out by means of which any ratepayer could have his premises wired at the expense of the Corporation, and he could hire the installation, the charge per annum being fixed at 1s. 6d. per lamp, and where two or more lamps were on one point, all lamps beyond the first were charged at 6d. per lamp per annum instead of 1s. 6d. Only plain fittings according to a schedule were allowed, 10 per cent. per annum on the list prices being charged as a rent on all higher price fittings. Alternatively, the consumer could buy the installation by quarterly instalments spead over three, five or seven years, interest calculated at 5 per cent. per annum on the balance outstanding being added, and the agreement between the consumer and the Corporation being entered into in each case with the landlord signing as a consenting party. The wiring in all cases was done by contractors.

This scheme has worked well in practice, and although the profit on the wiring scheme is small, yet it has been the means of inducing many people to become consumers who otherwise would not.

Motor Hiring.—The town in question offered, to the author's mind, a fruitful field for the supply of energy for power purposes, there being a number of small manufacturers and others using power; a scheme was therefore prepared by means of which motors could be obtained by any consumer on simple hire, or could be purchased by quarterly instalments spread over three, five or seven years. In each case, however, something had to be done to convince the intending consumer that an electrical motor was a desirable thing to have, and this was effected by allowing anyone to have a motor delivered to his premises, but fixed and wired at his own expense, and if at the end of three months he for any reason whatever was not satisfied, the supply authority would take it back, and he would simply pay one quarter's hire, and the transaction was at an end. At the end of the three months, however, to retain the motor, he had either to sign an agreement for its hire-purchase, or to hire it for five years certain. It is interesting to note that out of the several hundred horse-power of motors let on hire, not one motor was ever returned at the end of three months, and the supply authority now boasts of some 800 H.P. connected to its mains, and this in a town of only 35,000 people.

Wiring of Small Houses.—This, although a very desirable business to obtain, presented the greatest difficulties; at length, after considering the matter from all points, it was decided that the best way was to wire any small house (generally six or seven-roomed) absolutely free of charge on the receipt of a signed application either from the builder or the tenant. At first nine lights were put in, viz., a three-light fitting in the front sitting room with two wall switches; a single rise and fall pendant in the back sitting room with a wall switch; in the kitchen, hall and three bedrooms, a single light pendant with a key socket holder. The lights were all run on one circuit, and on a contract of 50 houses, the price paid was £3 10s. per house. Payment for the installation was made by charging an extra halfpenny a unit for the energy supplied through a slot meter, or through an ordinary meter, and the amounts were collected monthly. This scheme did not prove as satisfactory as was hoped, and for the following reasons :—

1. The amount expended on wiring bedrooms was practically lost money, as the units used in these did not pay anything like a fair rate of interest on the capital expended.

2. Owing to the false economy practised by the householders with regard to lamps, the light obtained from an old 16-C.P. was not good enough, and could not compete with a new gas mantle, and for this reason the consumers in some of the houses used incandescent gas in the room that was used for the longest number of hours in a day—the very place in which we wanted them to use electric light.

Hiring-out of Arc Lamps.—In the early days of the undertaking in Maidstone, a large number of tradesmen lighted the outside of their shop windows by means of clusters of three 16-C.P. lamps under an enamelled iron or opal shade, set at such an angle that the light was reflected on to the goods in the window.

When new the effect was not bad, but as the reflectors got old and dirty, and the lamps were allowed to become long past useful work, the effect was anything but a testimonial to outside electric lighting, and the expense of keeping the three 16-C.P. lamps going at 5d. per unit was out of proportion to the effect obtained. At this period the gas company came along with an outside lamp recently designed and called the "Maidstone lamp." This consisted of two 4-ft. burners set side by side and surrounded by a large well glass, sand blasted over half its circumference, and clear glass over the window half of the circumference. These fittings the gas company would erect outside any tradesman's premises free of charge, paint the tradesman's names on the frosted half, supply all new mantles that were required, and examine them once each fortnight for an inclusive annual charge of 10s. per lamp, the consumer paying for the gas used. The effect on the electricity undertaking was that before many months had elapsed many consumers had given up outside lighting. It was in vain that the author pointed out to the tradesmen that it was only by using arc lamps or Nernst lamps for outside lighting that a better effect was to be obtained; their reply was always to the same effect, namely, arc lamps were much too costly, both in capital outlay and up-keep, and too much trouble, and Nernst lamps were far too unreliable. Just when things looked worst salvation appeared in the shape of the numerous miniature arc lamps, mostly of Continental origin, with which the market was flooded. The author obtained samples of nearly every miniature arc lamp made, and submitted them to lengthened tests under ordinary working conditions, and it was with the greatest regret that he had to come to the conclusion that there was no arc lamp sufficiently reliable, and sufficiently simple in manufacture so that it could be repaired by the ordinary staff of a central station then to be had. In November, 1904, an English-made miniature lamp was sent to the author for trial purposes, and this proved so satisfactory, and was of such good manufacture, that the only wearing parts of the lamp could be replaced at quite a nominal figure, and that, after careful tests, the author was able to get out a scheme to enable the supply authority successfully to combat the gas company in the field of outside lighting. In the scheme that was got out, the following points were kept prominently in view :—

1. The arc lamp must be fairly small in dimensions and light in weight; the energy consumption must be such that a lamp could be kept alight for somewhere about 1d. an hour.

2. The hours of burning of the lamp must be reasonably long.

3. To secure efficiency, single enclosure was best.

Lastly, and most important of all, the consumer must be relieved of all the worry attendant on the use of arc lamps, and must be quite convinced that, should he make use of the lamps, they would not be liable to fail in the middle of a busy Saturday night, and refuse to light again.

Such lamps, costing somewhere in the neighbourhood of £2 each, and burning two in series across 230 volts with a current consumption of 2·2 amperes, were let out on hire at a charge of 6s. per annum, including the cost of carbons and trimming. So successful has this scheme been, that there are now 170 of these lamps in use in the town, and the users have nothing but praise for them, as regards both the light given and the cost of using them.

These miniature lamps are just what was required, for an ordinary provincial town has very few shops that will go to the expense of ordinary 500-watt arc lamps when very efficient gas lamps can be obtained for a fraction of the cost. But what the author considers of greatest importance is that the trimming and upkeep of the lamps should be undertaken by the supply authority.

The Inspection of Lamps, &c., on Consumers' Premises at Regular Intervals.—After the novelty had worn off electric light, and the more regularly used lamps on consumers' premises had become practically useless, owing to the blackening of the lamps, many complaints were received at

the station that the electric light was not nearly so good as it used to be, or that the pressure at certain places was much too low. On investigating these complaints, in nearly every case it was found that the lamps complained of were practically "niggers." When this was pointed out to the consumers, we were nearly always met with the reply that, beyond supplying people with electricity, we did not seem to care much what they did with it, whereas the gas company were always sending a man round to see that the gas consumers got the best value for their money. To overcome this objection, the Corporation took on a man who should visit each consumer at least once in every month to hear any complaints he had to make, to look over his installation and satisfy himself that it was alright, and to give any advice that he might require.

They also put into operation a system of lamp exchange, by means of which consumers of the Corporation were supplied with new lamps of the best manufacture in exchange for the same number of partly burnt out ones, at a reasonable cost. This scheme gave much satisfaction to the consumers, and was the means of many of them extending their installations, and of getting back several who had given up electricity and gone back to gas.

By the help of these inducements to use and to keep using electricity for lighting and power purposes, the undertaking made great headway, and the supply given gave general satisfaction to the consumers; in fact, so much satisfaction was given apparently that the Corporation was threatened with an action by the gas company and others, to the effect that unless they immediately stopped all trading, and confined themselves solely to the supply of energy and not doing anything beyond the consumers' terminals, an injunction would be applied for in the High Courts, as the Corporation were acting *ultra vires* of their provisional order. No one was more aware of this than the author, and it is on this point that a very large controversy is opened. On the one hand are the opponents of municipal trading composed to some extent of people having financial or other interests in rival concerns; and on the other hand, those members and officials of the Corporation, and large numbers of the general public, who hold that it is no use embarking in the supply of electricity for lighting and power purposes, unless they are allowed to use all those aids and inducements which nowadays are practically necessary if electricity is to hold its own, especially in a town where the gas interest has full powers to do practically as it likes.

The stock argument is that a municipality has no right to risk the money raised by rates or money raised by loan on the security of the rates, on such a flimsy security as motors, arc lamps and installations might afford. There is again a clause in most provisional orders stating exactly what shall be done with the profits derived from an electricity undertaking, but to set against all this is the fact that an electricity undertaking is much more likely to be a financial success, and by a financial success the author means a success when judged by sound business standards, than it is ever likely to be if its hands are to be tied, and its operations limited strictly to the supply of energy.

There is a large field for useful discussion opened up here, and the author sincerely hopes that the time is not far distant when the provincial boroughs may have the same powers for wiring and other work as are now possessed by the Metropolitan boroughs, and he is certain from his own experience that when these powers are obtained, a time of much greater prosperity will set in, not only for the supply authorities, but for the wiring contractors and the manufacturers of electrical apparatus, as he has in mind schemes by which all three may benefit equally.

Most of the opposition offered to all these schemes by the Electrical Contractors' Association and others is, to his mind, misplaced; all should remember the proverb of a house divided against itself, and when we are in this condition there is no gainsaying the fact that we are playing directly into the hands of the gas companies.

Electrical Production of Steel.—At a meeting of the German Iron and Steel Institute, which is to be held in Dusseldorf on December 9th, a paper on "Progress in the Electrical Production of Steel" is to be read by Profs. Eichoff and Rochling.

ELECTRICITY SUPPLY IN BIRMINGHAM: THE NEW SUMMER LANE STATION.

(*Concluded from page* 715.)

The transformers in the sub-station are arranged in groups of three single-phase transformers, each group being sufficient to supply energy to one of the rotary converters; the transformers are air-cooled, the air blast being supplied by motor-driven fans, arranged in duplicate.

The rotary converters are each of 300 KW. capacity; two of these are arranged for giving a direct current tramway traction supply, at a pressure of 550 volts, the fields being compound wound for this purpose.

Oil-cooled inductances are coupled to these machines.

One rotary converter is arranged for giving a supply for lighting and private power purposes at a pressure of 440 volts direct current; a potential regulator, controlled by a small electric motor, being coupled to this machine, for the purpose of regulating the pressure of supply as required.

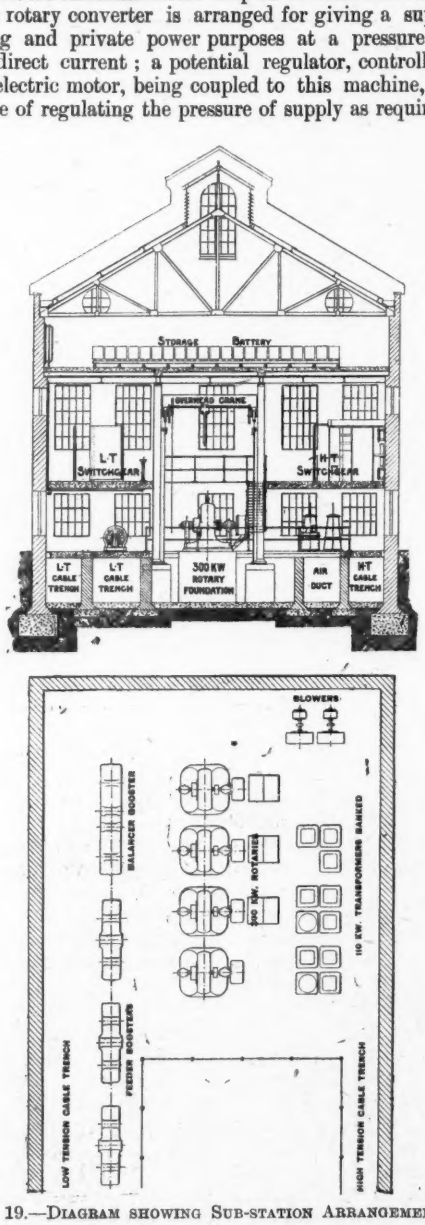


Fig. 19.—Diagram showing Sub-station Arrangement.

One rotary converter is arranged to act as a spare to either class of supply.

The extra high tension switchgear is constructed with the operating panels in front and cubicles at the back for accommodating the bus-bars and the oil-break and isolating switches.

The low tension switchboard is arranged in three sections, the first to accommodate the rotary converter panels; the second to accommodate the tramway traction feeder panels; and the third to accommodate the lighting and private power feeder panels.

The balancer, booster and battery panels are also arranged as required for each class of supply.

Direct-current boosters, driven by alternating-current motors, are provided for increasing the pressure of those lighting feeders that require it, at times of heavy load.

Direct current balancers of 50-KW. capacity, fitted with boosters at each end, have been supplied by the Phœnix Dynamo Manufacturing Co., Ltd.; the boosters are used for charging the storage battery, which has been supplied by the Electrical Power Storage Co., Ltd., the battery consisting of 256 cells, arranged across each side of the three-wire cable network, and 19 cells at the end of each battery being used for regulating purposes.

The capacities of the above sub-stations are as follows :—

Sub-station.	Initial capacity.	Ultimate capacity.
Parker Street	... 600 KW.	1,500 KW.
Camden Street	... 1,200 „	3,700 „
Court Road	... 900 „	2,100 „
Upper Trinity Street ...	... 1,200 „	3,700 „
Scholefield Street ...	... 900 „	2,100 „

It only remains to refer to the cable work, which has been of a very extensive character, and has been carried out by Messrs. Callender's Cable and Construction Co., Ltd.

Inside the Summer Lane station, special arrangements have been made to facilitate the running of cable connections and their subsequent repair. The central portion of the basement under the engine room, from the switch galleries to the other end of the building, has been divided into three subways, provided with a series of stone shelves built one above another into the side walls.

Four shelves are provided for each generator to accommodate the positive, negative, equaliser and shunt-winding cables respectively.

The direct-current cables are insulated with vulcanised rubber, and fireproofed with asbestos braid; the alternating-current cables are of the three-core paper-insulated, lead-

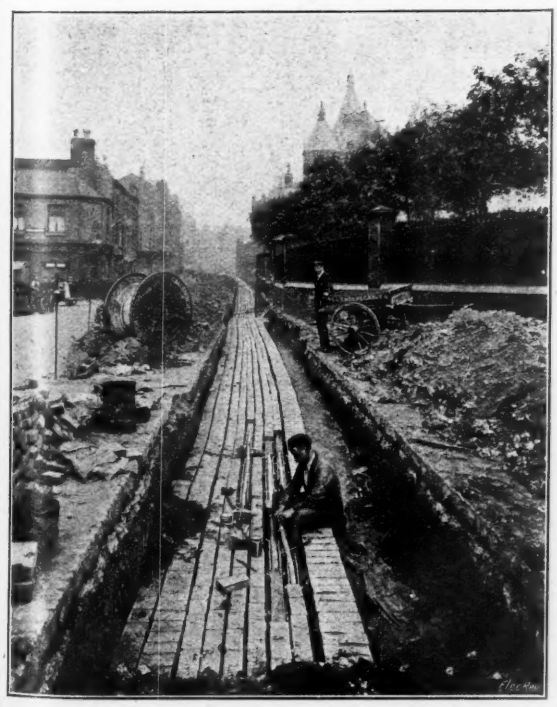


FIG. 20.—CABLE LAYING, ON THE SOLID SYSTEM.

covered and armoured type, and have a subway to themselves.

Under the switch galleries the cables pass up from the various shelves to the switchgear above.

The outgoing feeders pass through the Summer Lane end of the building into a subway under the pavement, which enables any cable to be run direct from its panel into the street; in fact, the cable work at this station is a model of orderliness.

The distributing network is divided into districts corresponding to the various generating and sub-stations; each section is fed by three-wire feeder cables, protected by fuses

FIG. 21.—SPECIAL DUCT WORK NECESSITATED BY OBSTRUCTIONS.

in the station and coupled solid to the network in underground boxes or feeder switch pillars. Adjoining networks are joined at certain points by fuses in the outers.

The positive traction feeders follow the normal practice; the negative feeders, however, are triple-concentric, this type having been used in order that adjustments may be made in the resistance of each cable and the potential drop adjusted to suit the traffic.

Pilot and telephone cables, the latter giving communication between the power station and feeder switch pillars, are included in the equipment.

The whole of the cable work is laid on the solid system; the L.T. cables are of the paper-insulated, vulcanised bitumen type supported on pot bridges in earthenware troughing, and run solid with bitumen; 2-in. brick tile covers are provided on the troughing as a mechanical protection.

The E.H.T. cables are similar to those used in the station; their armouring, consisting of galvanised steel wires laid over the lead, is earthed every 100 yds. to a cast-iron pipe fixed vertically into the ground beneath the cable and packed round with loose coke.

In conclusion, it may be mentioned that the energy sold during the year ending 1906, amounted to 5,383,904 units; the equivalent 8-C.P. lamp connections were 320,250, and the motor connections 3,279 H.P., figures, however, which will obviously be much increased by the acquisition of the traction load — estimated at 10-12,000,000 units per annum—in the near future, and the certain expansion in motive power supply to the outlying districts under the new arrangement and with reduced changes. It will be gathered that the scheme is a most comprehensive one, for which all credit is due to Mr. R. A. Chattock, the chief engineer and manager, who has been responsible not only for its inception, but for the carrying out of the work in its entirety. To him we are indebted for facilities extended to us in preparing this description.

PROCEEDINGS OF INSTITUTIONS.

High-Speed Electric Machinery: With Special Reference to Steam Turbine Machines.

By Prof. Silvanus P. Thompson, D.Sc., F.R.S.

Abstract of Howard Lectures delivered before the Society of Arts, *January 18th and 25th, and February 1st, 1906, and published in the Journal of the Society.)*

(*Continued from page* 699.)

If the resistance for 1 sq. in. be multiplied by the amperes per square inch, one obtains the voltage required to drive the current through the film, in other words, the contact-voltage. As the two factors vary approximately in inverse proportion to one another, the product is approximately constant, and is of the order of 1 volt for hard carbons. Fig. 6 shows the values for the hard carbon and the soft carbon of Siemens. With soft carbons the value is about 0·5 volt, or under. The values for copper brushes are much lower; but there is a curious discrepancy between the results found by different observers. Dettmar finds the value of 0·1 volt, increasing regularly with the current density, and attaining 0·25 volt when the density is raised to 124 amperes per sq. in. Arnold, on the other hand, finds a value of 0·01 to 0·02 volt. Pressure and surface speed make comparatively little difference to the contact resistance of copper brushes. There appears to be a maximum value at somewhere about 800 ft. per minute.

The lowness of the contact resistance of copper brushes prevents them from assisting commutation in the way that carbon brushes do. On the other hand, the contact-voltage of carbon brushes being about 1 volt, that is, 2 volts in total at the positive and negative brushes of the machine, they are not suited for machines of very low voltage such as those used for electroplating, since such a voltage-drop is too serious a fraction of the whole electromotive force of the machine.

Fig. 7 gives three sets of curves relating to the pressure. For the hard carbon of Lessing, the curves given show how, at a given density of current and speed of surface, the contact resistance is diminished by increasing the pressure. With ordinary dynamos and the usual carbons, the pressure found best in practice is from 1½ to 2 lb. per sq. in. If a lighter pressure is used the resistance is too high; and if the machine is not in perfect balance, or the commutator not perfectly true in outline, the brushes are apt to chatter. On the other hand, if the pressure is too great, the commutator is apt to be scored and cut by the carbons, if they are hard; or, if they are soft, the commutator surface becomes smeared, tending to provoke flash-over of the sparks. Friction at the commutator is, indeed, a not unimportant question. In the lower part of fig. 7 are given graphs of the friction losses in watts per sq. in. at three different speeds. Taking, for example, a pressure of 2 lb. per sq. in., and a surface speed of 2,000 ft. per minute, it appears that the friction losses amount to about 19 watts per sq. in. of brush contact. If we calculate out the watt losses (per sq. in.) due to the resistance and to friction, we obtain the total commutator losses per sq. in As the resistance losses go down, and the friction losses go up, with increase of pressure, there will be for each kind of carbon

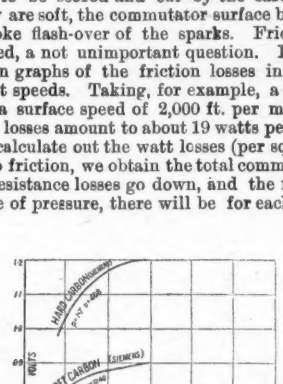


Fig. 6.—Relation between Current-Density and Contact-Voltage.

and each assigned speed one particular value of pressure which makes the total commutator losses a minimum, as may be seen from the upper curves of fig. 7. In designing ordinary generators it is safe to admit a loss of 60 watts per sq. in. of brush-contact.

Taking commutators as they are in ordinary dynamos, with carbon brushes, and assuming surface speeds not exceeding 3,000 ft. per minute, and pressures not exceeding 2 lb. per sq. in., we may then assume that they present, at the contact-film under the brushes, a transition voltage of from 0·8 to 1 volt. Careful observation shows that the value at the negative brush (where current flows from carbon to copper on re-entering the armature) is slightly higher than that at the positive. As a result the heating is slightly greater. From the energy point of view the presence of this contact resistance is a loss of economy and undesirable. But its presence is the whole secret of success in natural commutation. The price paid for the sparkless working of the machine is the voltage drop of 1·6 to 2 volts.

The theory of natural commutation by means of the contact resistances is very simple, and for the consideration of the ideal case needs no mathematical formulæ. If the other resistances that lie between the segments through the risers and the windings are relatively small, the distribution of the current will be governed by these resistances at the surface, or rather would be so governed if the change of current strength were not retarded by self-induction. Assuming that the self-induction is negligibly small, it is obvious that the flow of current will be regularly shifted, and

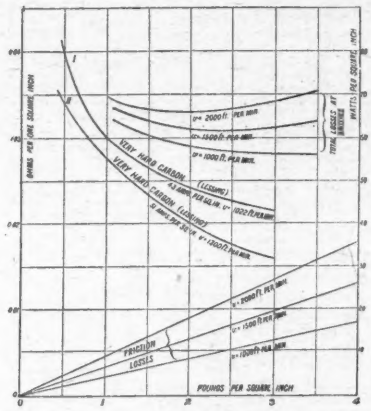


Fig. 7.—Relation between Pressure and Contact-Resistance.

unless there is any retardation of the changes, when the last stage is reached, the process of commutation of the current will be complete. But some resistance and some reactance are always present, and their effects must be taken into account. Resistance by itself has no effect on the whole operation; it assists the process of commutation during the first half of the period, and causes the current to die down at first more rapidly; but it hinders the process of commutation during the second half period, causing the reversed current in the element to grow less rapidly than it otherwise would do. There is, in fact, no justification for the custom adopted by some designers of using risers made of German silver or of rheostene or other alloy of high resistance in the hope of improving commutation.

On the other hand, the reactance of the element of winding has a dominant effect on the process of commutation. It causes the current in the element of winding to die down more slowly during the first part of the process, and also causes the reversed current to grow more slowly during the second half, with the result that, at the moment when commutation ought to be completed, the current has not yet attained its full value.

Forced Commutation.

Down to this point I have been dealing with the natural commutation brought about by the contact resistance of the brushes. But the older method, which was introduced when metal brushes were in vogue, is the method of *forced commutation* in which the reversal of the current in the element of winding is aided by the introduction, during the allotted period, of an induced electromotive force. There are two plans for the production of this reversing electromotive force: (1) To give a lead to the brushes; (2) to provide a special reversing magnetic field by the aid of an auxiliary pole.

The problem of securing a sparkless commutation at all loads, and with an invariable position of the brushes, was practically solved for ordinary slow-speed generators by the introduction of the carbon brush, and the design of the machine with saturated armature teeth and a stable magnetic field; but it has cropped up afresh in the particular case of turbo-dynamos.

Criteria of Commutation.

Many different criteria have been proposed to determine beforehand whether the commutation of a machine of given design will be satisfactory or not. For while the normal output of a generator may be temporarily exceeded by overloads of 25 to 50 per cent. without damage from overheating, or mechanical injury to the machine, if severe sparking is set up, even for a few minutes, the commutator will be damaged. It is, then, the sparking question which limits the normal rating of the machine. The following is a compendium of the chief rules:—

1. *Value of Commutating Field.*—

$$B_k = B_y\,(A\,T_{2y} - A\,T_z) \div A\,T_{2y},$$

where $A\,T_{2y}$ stands for the ampere-turns needed to drive the flux across the two gaps in a magnetic circuit, and $A\,T_z$ is the cross-magnetising ampere-turns per pole. In this rule it is assumed that the reduction of the flux under the pole-corner, in the neighbourhood of which commutation is to take place, is proportional to the reduction of the ampere-turns by reason of the cross-magnetising

effect. Such a formula is clearly only applicable to cases in which, by giving a lead to the brushes, a forced commutation is sought. If the value of this commutating field B_k falls below about 40 times q, or say, about 25,000 lines per sq. in., there will be trouble with the sparking.

2. *Stiffness Ratio.*—

$$B_g \div q = \text{from 80 to 100.}$$

If B_g is too low or q too high, so that this ratio falls below 80, trouble may be expected, because a high value of q implies a great distorting tendency, which must be fought by providing a dense field in the gap.

3. *Commutation Ratio.*—

$$\frac{B_g}{q \times e_k} = \begin{cases} \text{from 27 to 33 in 100-volt machines.} \\ \text{from 12 to 16 in 500-volt machines.} \end{cases}$$

Here e_k signifies the average voltage per segment of the commutation.

4. *General Electric Co.'s Rule.*—

$$\frac{A\,T_{2g} + A\,T_{2t}}{b \times q} = \text{from 1·3 to 1·5 at least.}$$

Here $b \times q$ is the number of ampere conductors at any moment under one pole, tending to distort; and the rule says that the number of ampere-turns of excitation spent on sending the useful flux across two gaps and along two teeth in the magnetic circuit must be from 1·3 to 1·5 times as great. Like Rule 2, this rule is an attempt to state a working proportion between the causes which respectively resist and produce distortion.

5. *Auxiliary Pole Rule.*—The preceding rules are for the case of ordinary dynamos; but where auxiliary poles are used the following rule is a useful guide:—

$$\frac{B_{aux}}{q \times l_i \times z} = \text{at least 3.}$$

Here B_{aux} is the value of the field beneath the auxiliary pole l_i the net length of iron in the armature coil parallel to the shaft, and z the ratio of the number of conductors in the armature to the number of segments in the commutator.

6. *S. P. Thompson's Figure of Merit.*—I have found a useful criterion to be afforded by the following empirical formula, in which I place in the denominator those quantities the increase of which is known to be bad as to their effect on commutation, and so obtain a figure of merit, f, which varies in different machines from 1·25 to 6, but which should never fall below 1. The bigger it is, the greater is the factor of safety of the machine.

$$f = \frac{10^8}{l_i \times q \times v_k \times z} = \text{from 1·25 to 6, or more.}$$

Here v_k is the surface speed of the commutator in feet per minute. All the quantities concerned are armature quantities. The formula says nothing about either the qualities of the brushes, or the disposition of the magnetic field or its fringes. It may be regarded, therefore, as a means of comparison between different armatures as to their probable performance in similar field and brush conditions.

7. *Hobart's Rule.*—Hobart has given the rule that the ratio of the reactance voltage (calculated in his particular way under the assumption that the current during the commutation-period varies as a cosine curve and not as a straight line), to the average voltage per segment should be less than unity; or—

$$\frac{e_r}{e_k} < 1.$$

For my own part I have never been able to see what the average voltage per segment has to do with the question, and more recently Mr. Hobart has stated that he no longer attaches any particular importance to this ratio; so that reactance voltage becomes a mere number, useful for comparing the probable reaction of one armature with that of another. If this is admitted, then it can be calculated much more simply by the formula:—

$$e_r = \frac{0{\cdot}21}{10^8}\{U\ m^2\ K\ C_1\ (10\ l_i + l_a)\}\ ;$$

where U signifies the revolutions per minute, m the number of turns per armature coil, K the number of commutator segments, C_1 the current in one conductor, l_i the net iron length of the armature, and l_a the length of coil free in air at the end-bend of the winding at one end of the coil.

8. *Arnold's Criterion.*—Prof. Arnold has given a formula in which he attempts to take into account not only the reactions of self and mutual induction, but also the specific properties of the carbon brush, in building up a formula for the value of the *final potential difference* which appears between the toe of the brush and the retreating edge of the commutator segment. In a machine that is not to spark its value must lie under 4 volts, and preferably should not exceed 2 volts. The calculations are complicated, but if we assume as the mean position of the brushes, that corresponding to satisfactory performance at half-load, the formula becomes

$$P_T = \frac{e_M + e_q}{1 - \frac{e_s}{P_W}}$$

where P_T is the final potential difference; e^M the voltage induced in a coil by the commutation of the current; e_q the voltage induced in a coil by the change of flux-density in the commutating zone by reason of cross magnetisation; e_s the effective voltage of the apparent self-induction of the short-circuited coil; and P a voltage dependent on the material of the brushes, having values lying for ordinary sorts of carbon between 0·6 and 1 volt.

9. *Arnold's Second Criterion.*—Arnold further says that $\frac{P_W}{e_s}$ should not be less than, but preferably greater than unity. This implies that the carbon voltage P_W should be as high as possible, or that to keep e_s low the mutual induction of the simultaneously short-circuited coils should be great compared with the self-induction of one coil; or, in other words, that the breadth of brush should be sufficiently great to cover two or three segments at least.

10. *Kapp's Criteria.*—Prof. Kapp has given two criteria, as follows:—

$$Y_1 = \frac{B_g \times x}{q},$$

$$Y_2 = \frac{K \times \delta}{d\lambda + x},$$

where x stands for the number of segments covered by the breadth of the brush; δ the width of the air-gap; d the diameter of the armature. Then, he says, a machine will not be satisfactory as to commutation unless Y_1 is at least as great as 38; nor unless also Y_2 is not less than 0·6 for carbon brushes, nor less than 1·2 for copper brushes.

I have tested the various criteria on a large number of standard machines, and have found none of them to give a truer indication than No. 6, though they are all useful in their several ways.

Compensating Windings and Auxiliary Poles.

Ever since the time when the existence was recognised of the magnetic distortion produced by the armature currents, in consequence of their cross-magnetising action, proposals have been made for neutralising their effect by means of compensating windings. It is self-evident that the compensating coil ought to be a thick wire coil inserted in series with the armature.

Various modes of arrangement were proposed, but were scarcely used because at about the time when they were proposed, the carbon brush was just coming into use. With the development, however, of machines employing peripheral speeds so high that ordinary carbon brushes cannot be used, it has been necessary to revert to metal brushes, and consequently to forced commutation, and to devices for compensating the distortion in order to maintain a fixed lead. In this revival of compensating windings Déri has led the way with a distributive coil closely akin to that of Ryan. Parsons has adopted a distributive compensating winding without a special commutating tooth. Brown has adopted Déri's plan with certain modifications. The Oerlikon Co. has used a distributive winding, but in its latest machines employs auxiliary poles as described below.

Windings for the purpose of annulling the cross-magnetising (or distorting) effect have sometimes been spoken of as cross-compounding windings. They are compound windings, more or less distributed, but arranged around axes that lie midway between the ordinary poles, and incidentally they *may* be arranged to magnetise a special commutating pole.

(To be continued.)

Birmingham Association of Mechanical Engineers.

On Saturday last Mr. W. H. Booth and Mr. H. Cruse read a paper on "Superheaters and Some Accessories." After discussing the properties of superheated steam, and its value in preventing initial condensation in the cylinder, the authors discuss the present practice of superheating, and describe the construction and operation of a superheater controlled by the flow of water through internal tubes, this water being used for feeding the boiler. The temperature of the flue gases in a separately fired superheater is reduced to 1,300° or 1,500° F. before they reach the superheater tubes, by the interposition of a water-tube boiler, without admitting an excess of air, as is often the case. Superheating is regarded by the authors as the most important step in modern steam engineering. Mild steel pipes and valve bodies are recommended, with junction pieces of the same material.

Society of Engineers.

On Monday evening a paper was read on "Recent Storage Battery Improvements," by Mr. Sherard Cowper-Coles. The author first referred to the comparatively small advance that has been made with the lead accumulator of recent years, although the industry is of considerable importance, the annual monetary output for storage batteries in England and Germany being estimated at nearly £1,000,000.

The important bearing thermo-electricity has on accumulators or secondary batteries was discussed, and ignition cells for firing petrol engines were considered; efficiency being of minor importance, it was maintained that primary batteries with reversible electrodes would be cheaper than storage batteries for this purpose. It was pointed out that there was no standard method of determining the cut-off point, and it was argued that if some basis of discharge were used by all makers, it would be easy to compare the output of different batteries.

The defects of the negative pasted plate were then considered, and the author stated that, in his opinion, the deterioration in the negative active matter was due to the fact that sulphate of lead is soluble in strong sulphuric acid.

The author then gave an historical sketch of the accumulator as far as relates to cells of a compact nature, and concluded that immediate future developments would be in the direction of electrodes which contain the electrolyte within themselves.

NEW PATENTS APPLIED FOR.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

23,380. "Improvements in and relating to variable candle-power electric incandescent lamps." T. N. Atkinson and H. E. Churchman. October 22nd. (Complete.)

23,385. "Improvements in telegraphy." I. Kitsee. October 22nd. (Complete.)

23,389. "Improvements in electric switch operating apparatus." I. L. Van Bushirk. October 22nd. (Complete.)

23,413. "Active materials for electric accumulators." H. Leitner. October 22nd.

23,415. "Improvements in electrical ærial apparatus for the conveyance of passengers, goods and the like." J. S. Chenhall. October 22nd.

23,422. "Improvements in regulation devices for electric currents." E. Caballero. October 22nd.

23,427. "Improvements in and connected with electric lighting devices for theatres and the like." W. P. Thompson. (The firm of Schwabe & Co., Germany.) October 22nd.

23,444. "Improvements in and relating to brushes for dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 22nd.

23,446. "Improvements in and relating to dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 22nd.

23,453. "Improved trolley head for electric trams, trains and the like." J. H. Green. October 23rd.

23,456. "Electrical and mechanical bolt for railway carriage doors and other doors and windows." W. Unsworth, A. Gibson and H. A. Leggatt." October 23rd. (Complete.)

23,467. "Improvements in electrical and clockwork advertising novelties." H. Pye. October 23rd.

23,469. "Combination electric alarm and pressure gauge for forced lubrication." H. E. Sharpin. October 23rd.

23,474. "Improvements in brackets and arms used as conduits for electric wires." H. Garner. October 23rd.

23,519. "Improvements relating to telephone circuits." C. M. Jacobs. October 23rd.

23,548. "Improvements in means for neutralising static electricity in yarn, paper and other materials." W. H. Chapman. October 23rd. (Complete.)

23,550. "Improvements in electric arc lamps." W. J. Davy. October 23rd.

23,563. "Improvements in and relating to dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 23rd.

23,564. "Improvements in and relating to brush-holders for dynamo-electric machines." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 23rd.

23,569. "Improved electric pedal for railways." E. Janssen. October 23rd. (Complete.)

23,584. "Improvements in brush-holders and carriers for electric generators and motors." A. E. Woodhouse. October 24th.

23,602. "Improvements in electricity meters." G. Hookham. October 24th.

23,629. "Improvements in electric switches." E. F. Moy, P. H. Bastie and E. F. Moy, Ltd. October 24th. (Complete.)

23,633. "Electric or other flash light combined with watches, clocks, cyclometers, compasses and the like." M. Melley. October 24th.

23,642. "Recording apparatus for telephones and like apparatus." A. H. Passmore. October 24th.

23,720. "Electricians' combination tool knife." J. Deakin. October 25th.

23,742. "Improvements in electrical time-switches." R. F. Venner and R. C. Priesbach. October 25th.

23,755. "Improvements in and relating to railway train electric lighting apparatus." A. C. Martin and R. H. Martin. October 25th.

23,781. "Improved electrical resistance thermometer." G. W. Johnson. (The firm of W. C. Heraeus, Germany.) October 25th.

23,800. "Improved means of automatically electrically connecting and mechanically suspending an arc lamp or the like and releasing same for lowering." J. Stevenson and O. R. Williams. October 26th.

23,810. "Improvements in or relating to electric ignition devices for internal combustion engines and the like." R. Ayton. October 26th.

23,828. "Improved process for the manufacture of metallic filaments for incandescent electric lamps." C. A. Lee. October 26th.

23,841. "Improvements in or relating to dynamo-electric machines." Siemens Bros. Dynamo Works, Ltd., and F. Lydall. October 26th. (Complete.)

23,851. "Improvements relating to electric arc lamps with convergent carbons." F. Ruzicka. October 26th. (Complete.)

23,854. "Universal instrument for measuring and gauging arc lamp carbons." C. Richter and H. Haser. October 26th.

23,859. "Improvements in magneto ignition apparatus for internal combustion engines." T. M. Foster. October 26th.

23,889. "Improved means for the regulation of the speed and power of electric vehicles." H. Leitner. October 26th.

23,894. "Improvements in and relating to electric motor control systems and apparatus." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 26th.

23,895. "Improvements in and relating to electric controllers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 26th.

23,896. "Improvements in and relating to electric motor control systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) October 26th.

23,898. "Improvements in electrical ignition devices for explosion engines." H. C. Brasier. (Date applied for under Patents Act, 1901, October 26th, 1905, being date of application in France.) October 26th. (Complete.)

23,944. "Improvements in electrical conduit fittings." H. Hirst and C. E. Gunner. October 27th.

23,951. "Improvements in dynamo-electric machines." H. G. Reist. (Date applied for under Patents Act, 1901, October 27th, 1905, being date of application in United States.) October 27th. (Complete.)

23,959. "Improvements in electrical measuring instruments of the moving-coil type." J. W. Record and H. Bevis. October 27th. (Complete.)

23,960. "Improvements in and relating to continuous current transformers." A. Gal. October 27th.

23,982. "Improvements relating to the regulation of the period of inductance f high frequency circuits." G. Ferrie. October 27th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1905.

Di-Electric Separators. A. J. Boult. (Sutton, Steele and Steele.) 17,653. August 31st.

Electric Batteries. G. Schauli. 19,616. September 28th.

Alternating Current Electric Motors. R. Lundell. 19,899. October 2nd.

Electric Alternating Current Switches. C. W. S. Crawley. 20,099. October 4th.

Systems of Electrical Distribution. R. Braun. 20,169. October 5th.

Caps and Contacts of Electric Incandescent Lamps. M. Favero. 20,512. October 10th.

Electric Controllers for Automobiles and the like. A. Dinin and M. Espagnent. 24,747. November 29th. (Date applied for under International Convention, December 9th, 1904.)

Electrostatic Watt and Watt-Hour Meters. E. Wilson and W. H. Wilson. 26,512. December 19th.

Electric Traction Systems. British Thomson-Houston Co. and F. W. Carter. 27,197. December 30th.

Protected or Armour-Clad Combined Electric Switch Fuse Plugs. H. H. Berry. 27,241. December 30th.

Electric Motors Especially Intended for Hoisting and Similar Purposes, and Systems of Control Therefor. British Thomson-Houston Co. (General Electric Co.) 17,843. September 4th.

Single-Phase Commutator Motors. V. A. Fynn. 20,368. October 9th.

Electric Motors. A. F. Pieper. 20,392. October 9th.

Electric Illuminating Apparatus for Advertising and the like Purposes. H. H. Lake. (H. H. Sylvester and P. E. Collins.) 20,473. October 10th.

Electric Arc Lamps of the (Inclined Carbon Type. F. M. Lewis. 20,609. October 11th.

Apparatus for Controlling Electrically Propelled Trains. Siemens Bros. and Co. and F. Lydall. 21,068. October 17th.

Apparatus for Moving Electrically the Points on Electric Tramways and Railways. J. P. Tierney and J. Malone. 22,763. November 7th.

Electric Switches. British Thomson-Houston Co. and J. M. Wallace. 23,804. November 20th.

Cases for Electrical Measuring Instruments. E. L. Everett and K. Edgcumbe. 25,224. December 5th.

Radiators for Use with Electricity, Oil or other Heating Agent. L. Betts and Improved Electric Supplies, Ltd. 25,855. December 12th.

Coin Freed Electricity Meters. J. M. Tourtel. 26,066. December 14th.

Electric Laundry Irons. R. Haddan. (E. H. Richardson.) 27,098. December 28th.

1906.

Safety Apparatus for Preventing Excessive Voltages in Electric Circuits. Siemens Bros. & Co. (Siemens Schuckertwerke-Ges.) 11,959. May 22nd.

Control of Electric Motors. A. Holmes, J. H. Holmes, L. W. Holmes, E. Holmes, G. J. Ralph and G. Page. 12,292. May 26th.

Detectors of Electric Oscillations. E. von Lepel. 18,693. August 21st.

Arrangements for Telephone Service Systems and Methods of Operating the Same. W. Ohnesorge. 1,934. January 25th.

Phase Regulation of Single-Phase Commutator Electric Motors Operated from Polyphase Circuits. B. G. Lamme. 2,605. February 2nd. (Date applied for under International Convention, February 6th, 1905.)

Means for Operating Conversation Counters in Telephone Installations. Siemens Bros. & Co. (Siemens & Halske Akt.-Ges.) 7,376. March 27th.

Telephone Apparatus. R. Bines. 8,175. April 4th.

Vacuum Tube Electric Apparatus. W. L. Wise. (The Moore Electrical Co.) 9,916. April 27th.

Process of Manufacturing Coils for Electric Purposes. R. J. Hopfelt. 10,457. May 4th.

Hoisting Gear, Especially Applicable for Raising and Lowering Arc Lamps. Veritys, Ltd., and F. S. Worsley. 13,085. June 6th.

Electric Traction Systems. Allgemeine Elektricitäts-Ges. 13,697. June 14th. (Date applied for under International Convention, June 14th, 1905.)

Arc Lamp. L. Ocenasek. 13,836. June 16th.

Sparking Plugs for Internal Combustion Engines. Electric Ignition Co. and F. H. Hall. 735. January 11th.

Alternating Current Electric Motors. W. M. Bradshaw. 1,481. (Date applied for under International Convention, February 1st, 1905.)

Circuit Closing Arrangements for Electrically-Driven Suspended Railway Cars with Hoisting Gear. F. E. B. Acland and B. Greiff. 2,735. February 5th.

Dynamo-Electric Machines. B. G. Lamme. 3,657. February 14th. (Date applied for under International Convention, February 21st, 1905.)

Incandescent Electric Lamps. M. Schade. 3,988. February 17th.

Electricity Meters. O. F. Blathy. 5,013. March 1st.

Process of Manufacturing Light Emitting Bodies for Electric Glow Lamps and of Connecting them with the Supply Conductors. H. Kuzel. 5,129. March 2nd.

Electricity Meters. Siemens Bros. & Co. (Siemens Schuckertwerke Ges.) 302. January 4th.

Dynamo-Electric Machines. F. H. Loring. 605. January 9th.

Electrical Welding of Chains. O. Kuppers. 1,289. January 17th.

Clocks for Connection with Electric Call Alarms or Bells. A. W. H. Rothwell. 3,250. February 10th.

Ships' Telegraphs. J. Wilkinson and J. D. Lynch. 5,698. March 9th.

Wireless Telephone Systems and Apparatus Therefor. F. J. McCarty. 8,324. April 6th.

Apparatus Relating to the Raising and Lowering of Electric Arc Lamps. J. Brockie. 8,144. April 4th.

Electro-Plating Apparatus. A. W. L'Hommedieu. 9,893. April 21st. (Date applied for under International Convention, April 22nd, 1905.)

Rotors for Dynamos and Electromotors. Bergmann Elektricitäts-werke Akt.-Ges. 11,901. May 14th. (Date applied for under International Convention, May 20th, 1905.)

Third Rails. W. J. Wilgus and F. J. Sprague. 12,344. May 26th. (Date applied for under International Convention, May 27th, 1905.)

Method of Producing Metallic Electrical Incandescence Bodies. Deutsche Gasgluhlicht Akt.-Ges. (Auerges.) 14,901. June 30th. (Date applied for under International Convention, October 28th, 1905.)

Electric Switches. L. Auerbach. 17,930. August 9th.